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The New Size

TO DESIGN a new dress for a magazine involves almost as much work as making a new gown for a lady. It is not merely a matter of getting some clothing—but of getting clothing that comports with the dignity, the characteristics of the magazine or person clothed. Therefore, for some months there has been much designing, much fitting that the new dress might be worthy of the Engineering Record, and might not only be agreeable in itself, but be dignified and forceful. We believe that we have succeeded in carrying out our intentions. We know that we have had much grief, with type sizes and type faces, with two-column-to-the-page and three-column-to-the-page make-up. We could have put more words on a page, by using smaller type or less spacing between lines. But the page would have been less inviting—and, above all, we are writing the Engineering Record that it may be read, for only by the reading of it can the matter be made valuable. We trust that the paper in its new form will not fail of the welcome it received in its old dress. As we have repeatedly said of late, the paper itself, in spirit, in force, in personality, will not change. Only the dress will be different.

Ice and Water Supplies

TO MANY waterworks men who are looking forward with anxiety to the freezing of their mains this winter, ice is just ice—an annual visitor whose calls are as regular as they are unwelcome. But the man who has studied the effects of low temperatures on water realizes that the subject cannot be thus summarily dismissed. The three forms of ice—surface, frazil and anchor—have different effects, while radiation, conduction and convection, all play an important part in the abstraction of heat from water. These topics are discussed at length in a timely paper by William W. Brush, deputy chief engineer of the New York Department of Water Supply, Gas and Electricity, just published in the December number of the *Journal* of the American Waterworks Association. Mr. Brush prefaces the experiences of the New York Water Department with subaqueous mains by a brief discussion in which it is pointed out that a main laid in salt water, without earth cover, is much more liable to freeze than one in fresh water. Water from a reservoir or stream, it is stated, seldom attains a temperature below 33 deg. Fahr. If, however, the temperature be further lowered during passage through the pipe, two things may happen: An ice film may form on the interior surface of the main, insulating it to some extent from further heat losses, or, if the velocity be high, frazil ice may develop to such an extent as to choke up the main completely. Mr. Brush adds some interesting information regarding the use of electric thawing. As a preparation for meeting the severe winter conditions which come in January and February a reading of Mr. Brush's article is recommended.

Review of the Year

IN CONFORMITY WITH CUSTOM, the Engineering Record presents in this issue a series of articles reviewing the status of those engineering problems or developments which, at the moment, seem to be of paramount interest. No attempt is made to cover every phase of civil engineering and contracting. In most fields there has been little marked progress. To attempt a review of their status would be to repeat what has already been said or what is so patent as not to need saying. The status of the engineer, success in contracting work, the prices of materials and labor are perennial questions. The progress toward professional unity, and the conditions created by the war have, however, given them an especial interest this year. The motor truck in its relation to the road, activated-sludge, federal highway aid and the engineer's relation to foreign trade are, relatively, new problems. All of them, the new and the old, are discussed in this issue by recognized leaders in their respective fields. We present the reviews with full confidence that through them the readers of the Engineering Record will get authoritative and far-seeing views of the various matters in question.

Pure Science and Utility

IS THE mere cataloging of the results of research to be the ultimate ambition of pure science? This is the text upon which Clemens Herschel, president of the American Society of Civil Engineers, based an address delivered last week before the annual meeting of the American Association for the Advancement of Science. Speaking with the utmost frankness, he told the scientists, in effect, to be useful, not merely erudite; to serve mankind rather than pin butterflies on cards. Not less interesting than Mr. Herschel's message itself was the manner in which it was received by the audience. Of several speeches by officers of national engineering societies his was the only one which evoked more than perfunctory applause. If this is indicative of anything, it is that pure science, whatever may have been its attitude in the past, is awakening to a new sense of responsibility and of opportunity. Certain it is that the European war has been the means of throwing light upon the possibilities of a closer co-operation between pure science and engineering—a co-operation which concerns itself not so much with the production of the implements and materials of warfare as with those of industry back of the firing line.

The Profession of Engineering

THERE has been much comment on the very rapid development in the broader relations which have developed among engineers in the last two or three years. It is apparent that some power is at work whose effect is to counteract the tendency to split off into new specialties. But though there has been much comment, there has been little attempt to discover the philosophical basis of the movement. Gano Dunn, in his article on "Professional Unity Among Engineers," page 4, presents what appears to be the basis for the remarkable synthesis now in progress. That basis is the unity in the thinking of all engineers—the scientific habit of thought. Put in another way, engineers are fundamentally scientists. They approach problems from the same angle. Their methods of investigation are essentially one. Consequently, when general problems are discussed the one engineer follows the other's reasoning with ease. There is quick response, ready sympathy. Fundamentally, it is this spirit that is bringing us together.

Retrospect

FROM the standpoint of the engineer and the contractor the year 1916 cannot be said to have been remarkable. Save for building work in industrial sections, the volume of construction was not in proportion to the country's development. From coast to coast the high prices of materials and labor have retarded the progress of work. Consequently, contracting organizations have gone along on a reduced scale. The employees have not suffered, because they readily found work in other lines. Whether many of them are lost permanently to construction work remains to be seen. Undoubtedly, with the slackening of activity which will mark the change from a war-business basis to normal operation many of these will find their positions less attractive than they are at the present minute, and will again seek employment in the field to which they are accustomed. Inevitably, however, the organizations must suffer because of their disruption. There is one bright thought, however, in contemplating the reduced construction record of the year now passed, namely, that the work held in abeyance must eventually be done, and that some time, as a result of the postponement, there will be an extraordinary volume of construction work, much to the advantage of both engineers and contractors. Whether the quickened activity will come this year is doubtful. Should peace be declared soon the revival might start this year, but all factors being considered—the temper in Europe and the probable length of the period of adjustment—it is likely that the volume of construction work in the civil engineering line this year will not be above normal.

The Prospect

A WAR YEAR must always be one of uncertainty, particularly when the conflict has reached the magnitude of that in progress in Europe. Consequently, the year 1916, despite its unprecedented business, was not of the kind to make us feel contented. Shall we be dragged into the maelstrom? What will happen at the war's end? Such were the questions that ruffled our business composure, that made us doubt and fear, even though the immediate business was phenomenally good.

At the present moment, though, there seems to be more confidence in the future than there was last January. There is still ample reason for speculation on the possibility of our being drawn into the war. There is also room for doubt as to what will happen after the war is over. Yet on the latter question, there is less fear than there was a year ago. Then observers freely predicted a severe depression as the accompaniment of the return of peace. Now, while there is some reservation, there is a well-defined confidence that our prosperity will continue for a year or more after hostilities cease. The prosperity may not be on the same plane that it is now, but it is believed that mills will continue running and all of our people be employed.

This feeling of confidence is based on both the foreign and domestic situations. In this country much needed work has been held in abeyance because of the high labor and material prices. When the war is over, capital will still be plentiful here, while the almost inevitably lower prices for men and materials will allow work to be executed on more favorable conditions than obtain to-day. Consequently, the quickened domestic demand will go a long way toward supplying to our mills the business that will be lost when war orders cease to come. What obtains here—the holding of necessary work in abeyance—obtains generally throughout the world, in both neutral and belligerent countries. In countries untouched by the war there will be more than the normal quantity of peace business, while in those unfortunate sections which have been overrun by the armies reconstruction must start on an entirely unprecedented scale. No matter how excellent the post-bellum industrial organizations now being planned in the various European countries, it is inconceivable that they will be able to take care of rehabilitation in the battle areas and the supply on a supernormal scale of oversea demand. Likely we shall have to change our basis considerably—our cost of production must be considerably lowered. This undoubtedly will come, and come quickly, and then we should have a large share in supplying the materials for rebuilding Europe and helping other countries catch up their retarded development.

It must be said, of course, that many factors will operate. What, therefore, will be the final result after the close of the war no one can positively predict. The best observers, however, are sharing in this feeling of confidence, expecting that the readjustment will be brought about quickly and without serious disturbance of our conditions. When Europe and the foreign countries have been served, after a year or two, then, these observers believe, will we face the real crisis.

The year 1917, therefore, starts out with a more hopeful tone than did 1916. It will have its full share of troubles, without doubt, but the dangers and difficulties are better appreciated and discounted than they were a year ago.

Valuation—Its Present Status—Prospects for the Future

LAST WEEK the long-awaited report of the special valuation committee of the American Society of Civil Engineers appeared in the *Proceedings* of the society. Until then the federal valuation of the carriers dominated the valuation picture even more completely than a year ago. The outstanding events of the year were the reporting by the Interstate Commerce Commission during October and November of tentative valuations of several railroads, and the filing of formal protests by two of these roads. While no really large railroad has thus far been included, the reports are significant in showing the general attitude of the commission, and in presenting test cases on which the Presidents' Conference Committee may be expected to concentrate its attention.

The American Society report proper contains 211 pages. It is preceded by an abstract, but although this contains 12 pages the committee hopes it will not be used by the members of the society as the sole basis for their conclusions and discussions. Snap judgment on so weighty a document would hardly be in order, and the Engineering Record will reserve detail comment until next week. The report looks, however, to have been worth waiting for. Out of the known divergences of views between the old and the new members of the committee have come an adjustment and an analysis that is apparently a credit to the society.

The principal bone of contention—the depreciation question—is met by the conclusion that whether or not depreciation should be deducted in rate cases depends on the character of regulation of the utility. Railroad renewals, except recently in the case of equipment, have always been and still are made as required and charged to operating expenses, without consideration of any accumulating renewal fund. The committee calls this the replacement method, and holds that under it no deduction for depreciation shall be made, unless there is deferred maintenance. Where the regulation recognizes the need for a growing fund, however, the committee thinks depreciation should be deducted, but credit should be allowed for whatever fund is found. In other words, the utility must not dissipate the funds in dividends, but may reinvest them as it sees fit. The old equal-annual-payment method is rechristened the compound-interest method, and is recommended where a fund is to be created.

Considerable space is given to the clarifying or modification of ideas previously set forth by the committee, but space limitations prohibit their discussion here.

Turning now from the academic discussion of valuation in general to the vital questions of the government's great undertaking, the first tentative valuations of the Interstate Commerce Commission are not encouraging. In the main the commission seems to have disregarded the arguments presented by the carriers and adopted the state-commission plan of keeping the figures down by main strength. True, the commission, finding it impossible, as was predicted, to trace actual original cost, and evidently unwilling to estimate it, has disappointed the state commissioners by declining to pitch out of the window the only obtainable figure—reproduction cost. True, also, the commission has rejected such fantastic theories as instantaneous reproduction, and public ownership of railroad land, and has revolted against presenting as reproduction cost of land what it knows is nothing of the kind. But it has still evaded the issue by reporting "present value" of land and giving no inkling of what it regards as true reproduction cost. Contingencies, working capital and development expenses have all been disregarded, and engineering and other overhead have been scaled down below what experience shows these things cost. Likewise, according to the railroads, in dealing with actual construction quantities, classifications, unit prices, construction periods and interest rates have been pared down. Properly, this journal believes, the commission, despite the protests of the carriers, has recorded accrued depreciation, which must have a bearing on sale value, but improperly and inconsistently it has disregarded such other values as advantageous location, which are reflected in net earnings and are certainly a part of sale value. Appreciation is likewise ignored.

Hence the significance of the public hearings soon to take place. The differences may be amicably adjusted, but the prospects are not bright. The Interstate Commerce Commission appears to have accepted the state-commission view that the paramount object and supreme necessity of the valuation is to keep the figures down. Unless it modifies its attitude extensive litigation can be expected when attempts are made to put the valuations to use.

Because of this state of affairs, the new report of the American Society's committee has appeared on the scene none too soon, and it is to be hoped that no flaws will be found in it to force it back on the committee. Perhaps the time has already gone by when the engineering profession can take a hand in the molding of valuation principles and policies; but if the society, as now looks probable, can put forth in the near future a fundamentally sound statement of principles perhaps much of the false theory that now seems so potent can be pushed aside.

Professional Unity Among Engineers

Splitting of Engineering Into Specialties Has Been Followed by Remarkable Synthesis, with the Scientific Method of Thought as the Common Bond

By GANO DUNN
Chairman, Engineering Foundation; President, J. G. White Engineering Corporation, New York

THE turn of the year would not be adequately chronicled if notice were not taken of the remarkable incidents, culminating in 1916, that can have nothing else for their explanation than the increasingly rapid growth of a consciousness among all who call themselves engineers that they are not isolated specialists but units in a profession of increasing importance and dignity.

It was easy a generation or two ago to discuss engineers as a class, for the class was small and relatively undifferentiated.

DEVELOPMENT OF ENGINEERING SOCIETIES

Making its appearance about the middle of the seventeen-hundreds, this class until hardly more than fifty years ago was regarded as composed of artisans or specially skilled laborers with whom, as a group, the world had little to do. Since that time, through the application of the scientific method of thinking, derived from the pure scientists and applied by the engineers, the features of the industrial world have been completely changed and the activities and welfare of communities, governments and peoples so greatly altered that the class, enormously increased in numbers, which has brought about these changes can with justice be said to have established a new and, in the eyes of the world, a fourth profession.

The civil engineers were the first to organize and all branches of engineering were included in their category. In this country differentiation began by the branching off into a separate organization of the mining engineers, who were followed in turn by the mechanical and the electrical engineers. The chemists founded their great organization directly prior to the organization of the mechanical engineers.

THIRTY ENGINEERING BRANCHES

At each of the above stages, subdivision was accompanied by large increase in numbers, and while the five groups referred to now constitute the principal national engineering societies, in one or more of which a preponderating number of the important engineers of the country hold memberships, the differentiation and subdivision have been continuing at an accelerating pace, until there are now recognized about thirty separate engineering branches, most of which have their own organizations. Radio, illuminating, refrigerating, heating and ventilating, industrial, agricultural, aeronautical, sanitary, metallurgical, municipal and other engineers, in a list too long to enumerate, constantly come to our attention.

When the tendency to differentiate and split off first appeared it was resisted by the great national societies in turn, in the fear that the new branches were but schisms and bode ill to the power and effectiveness of the respective parent. Contrary to expectations, the parent societies have increased in membership instead of decreasing.

It is not easy at this juncture to see, in respect to *technical activities*, what the fundamental tendency in all this amplification is. But in respect to *professional activities* he would indeed be without eyes who cannot read the signs of the times among engineers as a class.

THE SYNTHESIS

If it has been disconcerting to a telephone engineer possessed of pride in his profession to find himself increasingly specialized away from the electrical railroad expert or if a hydraulic engineer feels lost in the subject matter of the fluid frictions of the aeronautical engineer—if indeed the term "engineer" has come no longer to give an inkling of what a man actually does, let us not despair, for the very manifold diversity of occupation comprised under the term "engineering" of itself throws all engineers back upon and brings into brilliant prominence a quality they have in common.

That quality is their *method of thought*. It is this which is responsible for the remarkable events of the last few years, and conspicuously of the last year, and which is proving that engineers are indeed one instrument—a great profession.

From the radio expert to the metallurgist they all have followed in the steps of Galileo and have learned the scientific method, and it is this method and not the subject matter of their occupation that is building up the great engineering profession. The consciousness of training and experience in this method is the centripetal force evolving professional unity.

Perhaps I ought to add as an element of the professional bond the quality of action that derives delight in applying the scientific method to practical and useful purposes.

With a more or less unconscious sense of the bond goes a clearer feeling of dependence upon pure as distinguished from applied science and a recognition by engineers that at their best they are working with tools put into their hands by men devoted to pure science, that is, to research for its own sake.

THE SIGNIFICANT EVENTS

Amidst the apparent decentralization and dissipation of common technical interest accompanying extensive specialization and separate organization of branch after branch in the technical specialties of its own new field, what are the proofs of the synthesizing tendency to which this article is devoted?

In 1903 three of the great national engineering societies decided to live together in one home and founded the United Engineering Society, a corporation whose functions are wholly professional to the exclusion of the technical.

In 1903 in order to do honor to a great mechanical engineer four of the great societies established the joint administration of the John Fritz Medal Board of Award for the bestowal from time to time, in perpetuity, of the John Fritz Medal, the award of which was not limited to mechanical engineers, but thrown open to engineers of all branches.

In 1911 there was established by the American Institute of Electrical Engineers the beginnings of the joint conference committee of the four national societies in order to bring about co-operation between the electrical engineers, the American Society of Civil Engineers, the American Institute of Mining Engineers and the American Society of Mechanical Engineers.

In 1915, through the munificence of Ambrose Swasey, The Engineering Foundation, created by the United Engineering Society, was established for the promotion of scientific and engineering research and the good of mankind, which foundation is administered by a board of representatives of the great societies.

In 1915 the oldest and most distinguished of the engineering societies, the American Society of Civil Engineers, decided to give up its handsome separate home and come into the fraternity of its associate national societies.

PUBLIC ACTIVITIES

In 1915, also, the President of the United States recognized the importance of engineers in national defense and called upon the national engineering societies and chemists to designate representatives that should constitute the Naval Consulting Board and its subsidiary Committee on Industrial Preparedness. The establishment of this board and its adjunct marked an epoch in the relation of engineers to the nation, and the association with the engineers of the great national society of chemists also marked an epoch in the internal progress toward professional unity.

In 1916 was started the movement to form a Civic Scientific Alliance out of the material of the national engineering societies. The year 1916 also saw the beginning of what constitutes perhaps the climax up to date of the professional, as distinguished from the technical, activities of engineers—co-operation with the scientists in the formation of the National Research Council. The president of the National Academy of Sciences, the only scientific organization in the nation created by charter of Congress with the duty of serving the Government of the United States, was requested by President Wilson to create a council that should organize and co-ordinate all the governmental, educational, institutional, industrial and private agencies for scientific research, in order to further the national defense and the development of the resources of the country in time of peace.

The Engineering Foundation, standing in respect to this proposed council as the representative of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers and interpreting the growing sense of dependence upon pure science increasingly prevalent among engineers, proffered its whole resources to supply the funds and personal assistance needed by the National Research Council in its initial stages. Out of a corresponding appreciation of the importance of engineering in bringing about the application of the principles of science to the national and industrial problems of the country the proffer was accepted by the National Research Council and an important representation from the engineering profession was invited to sit among its members.

THE FUTURE

One cannot peruse the above chronology without the conviction that from many separated quarters the tendency of engineers to unite and exercise their influence, by virtue of the spiritual wealth they in common possess, is strongly manifest; nor can one escape the conclusion that this wealth binding them together is the sympathy springing from common possession of the scientific method of thinking and a love of action.

Viewing the tendency and witnessing its strength, it is evident that as a profession we are becoming consolidated and are on the threshold of greater accomplishments in our relations to society in general. With a strong sense of responsibility toward the nation and with rapidly developing machinery within our organizations for dealing with professional and public questions, we are not only fostering our scientific and engineering interests, but are creating a place for the engineer in national life.

Engineer's Relation to Foreign Expansion

Development Work Essentially of an Engineering Character—International Point of View and Broad Training Necessary for Success

By CHARLES A. STONE
President, American International Corporation

INTERNATIONAL *dependence* has acquired a new meaning to Americans since the outbreak of the European War. Those engaged in foreign trade or in industries closely affected by importations from Europe have realized that there was no such thing as international *independence*. They saw that nation was knit closely to nation by commercial bonds and that a ruthless and widespread severing of those bonds would turn the whole world topsy-turvy. But while some realized this international dependence, it required the shock of a world war to bring even the thinking class in the United States to a realization of international economic relations. So severe was the shock that even those who are not given to thinking about the broader problems that affect us as a people are aware that something has gone amiss, that the customary balance has been destroyed.

Viewed broadly, one effect of this great shock has been to start us thinking internationally instead of nationally. I do not say we have, as a people, made much progress in this (to us) new habit of thought. It is but a start. Yet it is encouraging. If we are to bear our part well as a member of the great family of nations we must readjust our views of foreign affairs, of foreign trade—of all our foreign relations, whether diplomatic or commercial. We must recognize that we are not to be an isolated nation, whose sole policy is to look to our selfish interest, to the neglect, as occasion dictates, of the rights of some nations and of our responsibilities to others.

International Point of View Needed

Since our foreign commercial and investment relations are much affected by legislation, and since this is ultimately a reflex of the nation's thinking, it is important that an international point of view be acquired by our people as a whole. Naturally our thinking classes must lead in this change in national viewpoint. Particularly is it necessary that those whose professions or avocations have a direct bearing on foreign trade and foreign investment development acquire quickly the broader outlook. Engineers are, needless to say, a necessary factor in this development. It is important therefore that, as a profession, we grasp the significance of America's present position in relation to world affairs.

It is unnecessary to present in detail the conditions that have brought foreign investment and foreign trade to the front. Unfortunately the point of view commonly taken is that we should take advantage of the embarrassment of European nations to win from them, so far as we can, their foreign customers and their foreign investment fields. The point of view to be encouraged is rather that America, having become able, no matter what the cause, to finance foreign work she should do her share toward world development. It may be said that the difference here emphasized is a mere quibble, that in any event the result is the same—a taking advantage of the situation which restricts the activities of Europeans. But the mental attitude may make a tremendous difference in the way we shall handle our world-trade relations after the war, and a tremendous difference, too, in the stand that foreign exporting countries will take toward us. The one attitude would encourage ruthless trade war; the other, by providing the funds which are now much needed, will lead to co-operation and may avert retaliatory measures. Our expansion into the foreign field, then, does not mean that we must take trade from European exporting nations. It means rather that the development of backward countries will be the more rapid and that in addition to English, French, German and Dutch capital, American money will be available for investment in foreign enterprises. There will be more business for all; the rate of progress in backward lands will be accelerated.

Expansion Inevitable

Moreover, while the war has tended to hasten our entrance on a broad scale into the foreign field, it was inevitable that we should eventually take our part in world-development work. Less and less have we had need for foreign financial help in our domestic enterprises. At the same time our exports have been growing. Before long there would have been surplus capital here that would have sought employment abroad. The war has merely hastened the day.

If we turn to the foreign-trade histories of England and Germany we will find a counterpart of our own progress toward wide trade relations. England has been the great developer of nations. She became so through her attainment early in the last century of a strong financial position and of pre-eminence in manufacturing. As Germany's wealth increased and as she became largely a manufacturing nation she, too, sought employment abroad for her capital and a market for her surplus products. Now, in turn, these two factors—great wealth and a large volume of manufactures—are putting the urge upon America.

The Engineer's Rôle

A closer view of England's foreign-investment progress and foreign-trade expansion of the last century will indicate the agencies we must employ and will show how vital is the position of the engineer in our future expansion. England's pioneers in all cases were the engineers and their co-workers, the contractors. The professional promoter is an American product. The development of a country is essentially an engineering task—the building of railroads, of ports, of municipal works, of public utilities. England's mechanical and engineering superiority in the early part of the last century, combined with her wealth, fitted her admirably for such development work. Great firms sprang up that carried British engineering genius to every part of the world—and where England's engineers went and invested English gold, English trade followed. Thomas Brassey, the well-known contractor, whose life written by Sir Arthur Helps reads like a romance, was one of the greatest of these English engineering pioneers. Having demonstrated his capacity in the building of the London to Southampton railway, he subsequently built the line from Rouen to Paris, and within some fifteen years of his London and Southampton work was employing 75,000 men on work involving a capital outlay of $180,000,000. The work was scattered through France and the United Kingdom. Then came his marvelous expansion into foreign fields—Holland, Prussia, Spain, Italy, Canada, India, Australia and South America.

Others followed in his footsteps, and to-day such great firms as S. Pearson & Son, Ltd., Sir John Jackson, Ltd., Pauling & Company, Ltd., and C. H. Walker & Company, Ltd., engineers and contractors both, continue to serve as the pioneers for English trade expansion, for trade follows investment, and these firms build English investment money into public works, utility systems and industries.

Lessons from Europe

Powerful German engineering and construction companies, such as Philip Holzmann Aktiengesellschaft, have developed, too, and their work forms the basis for greater German trade.

We now have the material basis, surplus funds, for foreign expansion. But if we are to follow in England's and in Germany's footsteps we must have, as they have had, a large number of able engineers, broadly educated, as soundly grounded in economics as they are in engineering and who have the will to engage in work in foreign lands. Moreover, as has been already emphasized, they must be trained to think internationally. With engineering ability to solve problems here at home we are abundantly supplied. The foreign field, however, manifestly demands greater abilities, broader training and wider vision. If we are to bear our part well in the future world development our schools must appreciate the need and prepare the men for the task. Happily some of our great engineering schools, among them the Massachusetts Institute of Technology, Cornell, Sheffield and Rensselaer, are awake to the opportunities, and in a very few years we shall have our graduate engineers trained to think and to speak internationally and find many of them seeking the opportunities which await them in foreign lands.

America will profit not only through the direct returns and through the stability which will result from a large foreign trade, but through the contact with world conditions that will bring new viewpoints and experiences to help solve our national problems.

Making a Success of Road Contracting

Summary of the Factors That Need Attention in Getting the Contract and in Executing the Work—Imagination a Necessary Quality

By H. ELTINGE BREED
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ALL contract work is hazardous. That the building of roads has perhaps more often than any other form of construction proved itself a losing venture for the contractor is due to many causes. Within the limits of this article we can suggest only a few, general ones, which apply with equal force to every piece of highway work and for which there are definite remedies. They will be discussed under two general heads, "Getting the Contract" and "Doing the Work."

First it may be noted that many contractors who are successes in other classes of work fail when they attempt highway work. Why? Because they lack imagination. They fail to discriminate between the static piece of work, such as a skyscraper, a bridge or a dam, where they can keep the whole procedure constantly under their eye, and the prolonged stretch of work on the highway, where their personal supervision at any one time can cover only a small fraction of the work. The highway is 10 miles in length. The contractor at no point can see more than 90 yd. His imagination must carry him over the 17,510 yd., meeting every condition his workmen are meeting, dovetailing every detail to a nicety, inspiring his force with esprit de corps—an intangible asset worth many dollars on any job. If the contractor lacks this power of imagination, if he cannot project his personality through space into the minds and hands of every workman, then he had better stay out of highway work.

Getting the Contract

But supposing he can honestly tell himself that he has these personal qualities, then his immediate practical concern is to get the award of the contract. He must prepare his bid. In doing this the essential thing it to make a thorough examination of the project in hand, personally, if his experience warrants it, or through the employment either of an experienced contractor or of an engineer who has had contractual experience. The contractor who tries to avoid the expense of such services often disregards important factors or cheerfully accepts them as hazards which may come out all right, but which, going entirely against him as they often do, may cause his financial downfall.

These are important items to be considered in looking over work: (1) Plant, (2) local data, (3) climate, (4) financial arrangements, (5) cost data. They will be discussed in order.

1. PLANT

Has the contractor plant suitable for this particular job? Does he wish to buy such plant as a permanent investment? Will it pay to buy special equipment for this one piece of work?

While the difficulty and cost of getting labor constantly increase and its efficiency as constantly decreases, plant may often be made to pay for itself. Special equipment, even, may so reduce the price per mile as to lower the bid even after the first cost is included. But the contractor rarely wants increased plant to represent all his profit on a job.

Further considerations about plant should include: (a) the relative economy of portable and semi-portable plants, (b) ease of manipulation of various units of plants, (c) transportation facilities for placing and moving plant.

To form an intelligent estimate of the price to be charged against the items for plant, one must figure the approximate cost of the plant, plus its depreciation and repairs, plus the cost of its operation and supplies, plus the cost of transportation to and from the work, and the setting up, less the salvage value when the work is complete. One must estimate its average daily capacity. With steam-shovel work, one must plan for enough equipment to keep the shovel continuously busy.

2. LOCAL DATA

Under this head, accurate computations can be made only by one thoroughly familiar with local conditions.

He must know the local labor market. Will his men work eight, nine or ten hours a day? At $1.75 or $2 or $2.25? Compensation and insurance must be figured.

He must know the situation in respect to materials—their accessibility, cost, available quantities, methods of transportation and length of haul.

He must know what provisions will have to be made for maintaining traffic.

He must decide whether pipe line will have to be installed to secure an adequate water supply.

He must determine the character and formation of the rock, and the depth of cutting.

He must understand the soil conditions and drainage, and be able to estimate the amount of wet excavation in ditches and foundations.

He must gage the necessary shifts of plant.

3. Climate

On climate and the number of working months depends the length of contract a man ought to take for one season. If the climate is bad, the work will be delayed. Under fair climatic conditions, such as obtain in most of New York State, a man could safely undertake from 3 to 6 miles with one plant and from 6 to 12 miles with two plants.

4. Financial Arrangements

Organization costs money. Overhead charges and superintendents' salaries must be counted in the cost of work. The contractor *must* have sufficient capital at his command to meet these charges, to pay for whatever new plant he needs, to cover transportation and freight charges, to meet his first payrolls, and to do the early part of the work, which is often the most expensive and unprofitable part. The interest on this capital, whether borrowed or not, should be added to the bid.

5. Cost Data

"Handle with care!" Cost data represent averages. Conditions peculiar to a particular piece of work may vary those averages 100 per cent. On the wrong side, they may spell failure.

After these points have been carefully weighed, a few other suggestions may protect the contractor from an injudicious bid.

1. Bid a price sufficient to pay for new plant necessary, less its salvage value, and charge off depreciation of plants against your profits.
2. Protect yourself on the prices of all materials.
3. Figure everything accurately. Don't guess.
4. Remember that contingencies arise.
5. Bid higher if the market in labor and materials is rising; lower if falling.
6. Study your specifications.
7. Remember that the unit price depends on the size of the job.
8. Avoid "office bids," as the easy path to failure.
9. Estimate your profits.
10. Make *your own* bid; other contractors may make unbalanced bids or have special facilities for doing the work cheaply.
11. And don't try to beat the other fellow just because he once beat you.

Doing the Work

When the contractor has submitted his bid, and has been awarded the contract, he should begin work at once, taking up the key piece of the jigsaw puzzle, about which every other piece must be ready to fit instantly with absolute precision.

The key piece is his financial arrangements. Weakness here is the cause of many failures. If a man's credit is poor, he must pay a higher price for all materials. If he is behind on his payrolls, he gets less work out of his men. If he has to assign his estimates, he becomes an object of suspicion to all who do business with him. For success and for his own happiness he *must* have adequate financial support. This must cover overhead expenses and payrolls until the work is in full swing; bond, insurance and compensation; installation of plant, and new plant to be acquired; materials and freight charges. He must remember that until a large percentage of the work has been done, and the payments for it begin to come in, he will have to keep on investing more capital every month. In requesting loans, therefore, a man should estimate liberally, and then keep within them. That inspires a bank with confidence, and means good credit.

How to Organize

A competent superintendent should be employed, one who has the ability to do everything without recourse to an overhead organization. He should be given authority and power to act in full whenever it is necessary. He must possess character, business ability and the qualities of leadership.

The most successful contractors organize their work on the basis of time, allowing a definite number of months for the completion of the work. By arranging a schedule, the contractor with imagination will plan exactly how and when each item can be done, what materials it will require, the time of their delivery, and the perfect adjustment of all the different classes of work, so that the job may move forward as an entity and not as a process of loose ends.

It is poor policy to try to do all the profitable items of work first, such as placing the pavement before the drainage has been perfected. Large losses may result from such procedures, especially if the weather turn bad.

Plant, Labor, Methods

Necessary plant should be procured at the lowest possible expense. It should give the lowest unit cost when figured on a basis of time. By decreasing labor costs and labor troubles it may turn the scale against a losing job. It should always be supported on adequate foundations, which are cheaper than the smash-ups and delays caused by the lack of them. Extra parts should always be on hand in case of accident. Money will be saved by careful planning for the smallest number of set-ups.

There is no better asset on a job than a force of well-cared-for, contented workmen. The contractor will get much better results if he engages the men himself, instead of obtaining them through the contract system. To do this may require a larger outlay in money and energy, at first, but it will give returns beyond measure. They will further increase if the men are provided with good quarters and an economical commissary. The men, as well as the machines, need care and fuel if they are to be 100 per cent efficient.: They need something more —good discipline, and a good working spirit diffused among them by the superintendent and contractor. The grumblers should be ousted and the good workers advanced as far as possible.

The successful contractor is always on the alert to improve his methods. Because a job is going well, it does not mean that it might not go better. Profits may always be increased by attention to details of procedure. When the daily cost of one method of work has been ascertained it is often wise to test another method and compare results. The work should always be planned so that, once started, the men can work uninterruptedly at one thing for a full day.

Points That Contribute to Success

Here are some points that contribute to a contractor's success in highway work:

1. Always make excavations for cuts uphill; this drains your work.
2. Upon good drainage depends your ability to keep your men working.
3. All your contracts for materials should be executed for the life of the work.
4. Keep all your work going together, and keep your full-time men busy on rainy days; you can find something for them to do.
5. Keep your roller going all the time. You pay your roller man; make him work.
6. Have your materials ready in advance; then you will not be delayed when you are ready to use them.
7. For concrete work, buy the type of mixer that will do for both base and pavement work.
8. Keep each man at his own job in his own place. To let the men get in one another's way wastes time and money.
9. Keep your cars unloaded; don't pay demurrage.
10. Provide enough labor and teams to keep your plant working at full capacity.
11. Good storage facilities save your materials and your money.
12. Remember that it costs from $200 to $500 a mile to winter finished work.
13. Remember that every day over your time limit increases overhead charges and decreases your profits.
14. Successful work proceeds throughout the day in well-ordered continuity.

To Sum Up

Briefly, the success of large and small contractors in road work depends upon their ability to conduct a flexible, shifting organization; to plan and execute a mass of details, each trivial in itself, but contributing importantly to the whole; to "plant" work economically; to realize that intensive methods will not apply to extensive work; to obtain a good working force and especially a good superintendent; to finance the work adequately, and find profit in dollars rather than plant.

The suggestions above are generalities. Upon the human factor depends their successful application. Not every man can be a contractor; not every contractor can be a success in highway work. But the man who can, the man who possesses the personal qualifications and the understanding of working principles, will be a valuable factor in the nationally beneficial work of extending the mileage of good roads.

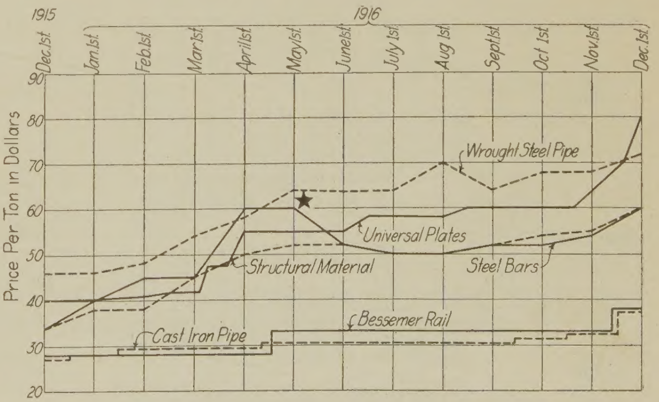
Material Prices Reflect Labor Conditions

Except for Steel, Where Heavy Demand Has Accounted for Portion of Advance, Increases in Prices of Construction Materials in General Appear Due to More Permanent Causes

By HENRY D. HAMMOND
Associate Editor, Engineering Record

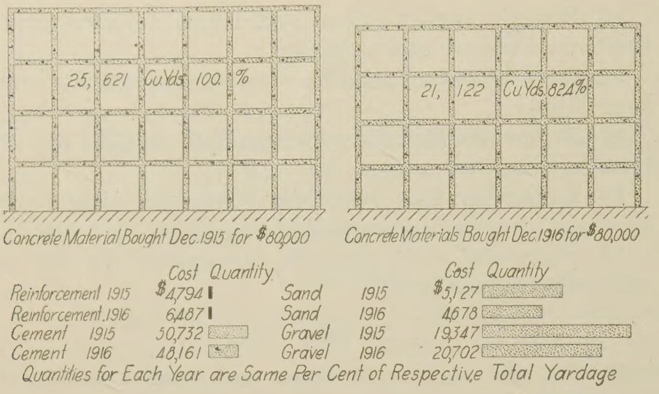
PRICE INCREASES are usually due to one of two kinds of causes. The first are those resulting in an increase of demand beyond visible supply and the second in increase in the cost of production. Causes of the first kind may be, and usually are, of a temporary nature. Causes of the second kind are generally due to permanent changes and readjustments of the entire economic structure. When temporary abnormal demand eases off, prices advanced by this demand will drop. On the other hand, when labor, standards of living, costs of most raw materials and production costs in general have increased, forcing a rise in the price of commodities, even those economic upheavals known as panics are powerless again to level prices except for the moment. Price advances from the second set of causes are therefore likely to prove permanent.

Of the price advances during 1916 in construction materials, illustrated in the charts and diagrams, only those of steel products are due to a combination of causes of both kinds. Other materials have changed less consistently and through a smaller range, and the causes for gains, where these are shown, may be traced in nearly every case to the second group. Advances in steel prices, therefore, so far as they are chargeable to abnormal demand, may not be maintained when this demand falls off. On the other hand, that portion of the advances in steel prices due to increasing production costs and most of the advances of other construction materials must be considered as more permanent. Prices for such materials may again fluctuate below the levels of 1915, but the history of economic progress shows that they can never be expected to settle *perma-*



RAIL AND CAST PIPE STICK CLOSE TO PRODUCTION COST, WHILE OTHER ITEMS SOAR ON EXCESSIVE DEMAND

The star indicates the point where mills began to distinguish between open-hearth and Bessemer steel, lower prices being quoted on the latter steel to move it more freely.

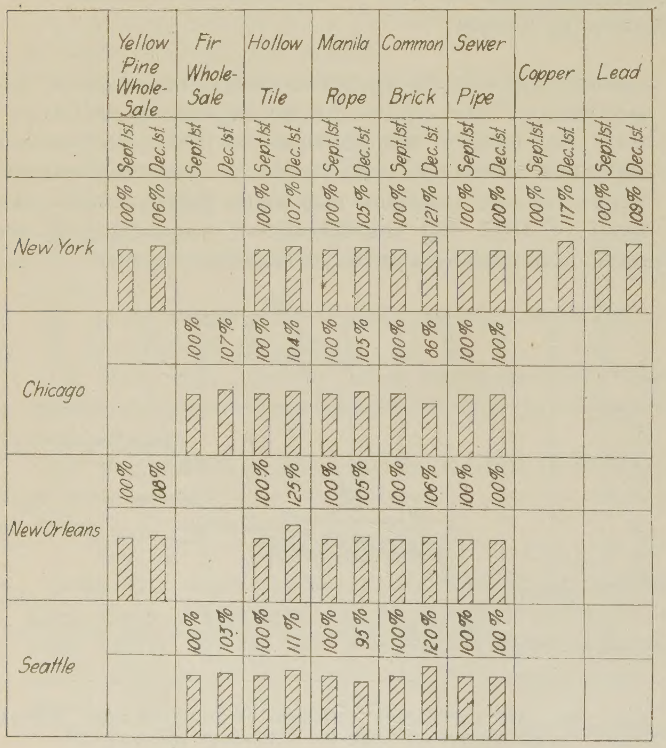


EVEN IN REINFORCED CONCRETE, OWNER'S MONEY WILL NOT GO SO FAR AS LAST YEAR

The case shown is for New York, where active demand from subway and building work has made unusual prices for gravel. Even here, however, the advance in cement is the controlling factor.

nently at the figures recorded before the advance set in.

A permanent economic gain has been made by the United States during 1916 which overshadows any similar gain in its history. One of the best known of American economists, for instance, computes that if the permanent advance in this respect between the end of 1903 and Jan. 1, 1916, be set at 325 per cent on an arbitrary scale, the total advance between 1903 and the end of 1916 must be placed at 533 per cent. In other words, one-third of the entire gain during the thirteen-year period has been achieved during the past year alone. According to this reckoning, our population is producing at a higher ratio and there is more material wealth and more currency per capita in the country than formerly. In view of these fundamental economic conditions, it is natural to find prices advancing from underlying and potentially permanent causes. In view of the further fact that net losses, due to industrial setbacks in the past, have always been but a small fraction of the preceding advance, it is natural also to conclude that the price gains due to such causes as those mentioned will be maintained in the long run.



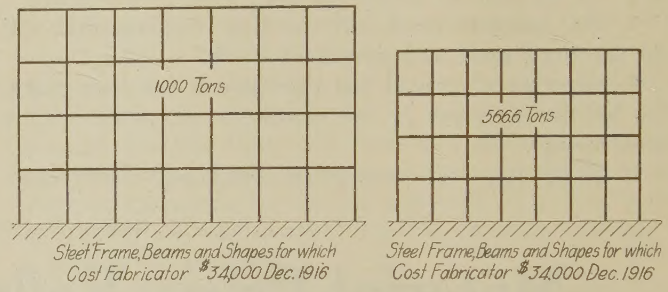
	Yellow Pine Whole-Sale		Fir Whole-Sale		Hollow Tile		Manila Rope		Common Brick		Sewer Pipe		Copper		Lead	
	Sept. 1st	Dec. 1st	Sept. 1st	Dec. 1st	Sept. 1st	Dec. 1st	Sept. 1st	Dec. 1st	Sept. 1st	Dec. 1st	Sept. 1st	Dec. 1st	Sept. 1st	Dec. 1st	Sept. 1st	Dec. 1st
New York	100%	106%			100%	107%	100%	105%	100%	121%	100%	100%	100%	117%	100%	108%
Chicago			100%	107%	100%	104%	100%	105%	100%	86%	100%	100%				
New Orleans	100%	108%			100%	125%	100%	105%	100%	106%	100%	100%				
Seattle			100%	103%	100%	111%	100%	95%	100%	120%	100%	100%				

PRICES CONTINUED TO ADVANCE AS CONSTRUCTION SEASON CLOSED

Increase in Fabricating Costs and Price of Rails Significant

As to how much of the increase in steel prices is due to permanent causes and how much to extraordinary demand created by the war, we have few better indications than the price of rails. Referring to the chart, it will be seen that the price of Bessemer rail has advanced almost 36 per cent, while the average price advance of structural material, plates, bars and wrought pipe is just above 56 per cent. Assuming, as is usually done, that rail prices have been held to as low a level as mill costs would permit, it appears that but $15.50 of the average gain of $24.50 per ton scored by the other four products is due to fundamental causes. On this basis, the extra gain of $9 per ton is caused by a great temporary demand for steel products, and it is therefore likely to vanish when this demand ceases.

Significant as another witness to this conclusion is an analysis of the increased cost of fabricated steel-building frames. Complete figures are available for a typical case involving two large power-house frames let in the same district of an eastern state, one in December, 1915, and one last month. The price of the plain material, as it happened, was in each case the price shown in the accompanying steel-frame diagram. The price of the fabricated frames, however, did not vary in the same proportion. Instead of showing a 76-per cent increase in delivered cost, the same per cent increase as for the plain material, the delivered cost of the second frame was only 63 per cent greater than that of the first frame. In other words, while material costs jumped from $34 to $60 per ton, fabricating costs rose only from $21 to $30 per ton. Thus, fabricating costs, which represent in this case costs resulting wholly from causes belonging in the second group mentioned, show an indicated advance of 48 per cent. Therefore, it may be argued, only two-thirds of the 76-per cent gain in the price of the plain material must be charged to underlying causes, while the other third is due to the temporary excessive demand for steel products. This checks with reasonable accuracy the percentage of the advance in steel prices which was found to be permanent by taking rail prices as a base.



PRICES OF PLAIN STRUCTURAL MATERIAL HAVE ADVANCED 76 PER CENT

Advances Caused by Growing Cost of Manufacturing

As to other construction materials, only in a few cases can it be argued that excessive demand has caused price advances. On the contrary, there has been no excessive demand. Reliable statistics, including the operations of every fabricator of consequence in this country, show that the amount of construction into which fabricated steel has entered has been less during the past year than in 1915. Statistics for general building construction show a gain, it is true. Yet, although concrete and wood have replaced the high-priced steel in many projects, and though industrial building has more than proportionately doubled, statistics indicate that the total volume of building for 1916 will fall well below that for 1909 and may not much exceed that for 1912.

For general construction work, no reliable figures are available. Undoubtedly, however, such work has, except for highway construction, been far from active. For every important letting there is a flock of hungry bidders. No general contractor, aside from those in the building and road fields, will point to 1916 as a normal season. Where, then, is to be found evidence of increased demand to account for the slight price advances noted in most lines? The answer is that these rises must in general be accounted for on some other theory.

One cannot escape the impression that the increased cost of labor and raw materials has compelled the manufacturers of most construction supplies to raise prices in a market not naturally favorable to such advances. Prices have gone up, where they have been able to rise at all, because general business is on a higher level, and the producers of construction materials, caught between the devil and the deep blue sea, had to put them up or retire from business. Naturally, these increases have resulted, in connection with the cost of steel, in curtailing still further the volume of construction. It must be remembered, however, that these increases are only an intermediate factor in the curtailment, so widely complained of. The underlying causes are to be looked for in the general labor shortage and the general increase in production costs, combined with the fact that peculiar circumstances have continued to keep the railroads, a most important group when it comes to keeping the general contractor busy, out of the market.

Contractors Meet Labor Shortage with More Plant and Better Organization

Replies from Large Firms Whose Operations Cover Country Indicate Growing Seriousness to the Construction Business of Labor Scarcity

By HENRY D. HAMMOND

Associate Editor, Engineering Record

A SCARCITY of labor over most of the country is being met by efforts to secure increased efficiency by the use of more labor-saving tools and more careful planning and organization. Such is the gist of replies reaching the Engineering Record from large contractors in every part of the United States in response to a request for information on the labor situation. It is evident from these replies that throughout the entire country, except in the thinly-populated Southwest, common and skilled labor for new projects is increasingly difficult to secure and increasingly restless and hard to keep. Labor conditions are forcing a consideration of the human element and a use of construction plant and of improved methods of planning and organizing work such as this country has not seen before. While it is true that promoters seldom consider directly the market for construction labor in starting new projects, it is yet evident from these replies that the general labor shortage, resulting in higher construction and material costs, in slower deliveries and often in slower construction progress, has been a major factor in curtailing the volume of construction work, and is likely to have a still greater effect next year.

SHORTAGE NOW COVERS MOST OF COUNTRY

The actual changes in the labor situation since 1915, and especially since the end of last May, when a similar census was taken on this subject, from which one of the accompanying maps (reprinted from the Engineering Record of May 20 last) was made, are highly significant. It will be seen that wages in the northeastern quarter of the country, containing more than 60 per cent of the population, have not risen since last spring. This can only mean that the limit has been reached in this territory beyond which costs cannot advance without shutting off work. Indeed, for some groups of clients, this limit has been passed and their work is actually being postponed at the present time. In general, clients of contractors cannot compete with the wages offered by manufacturing and munitions plants for common and skilled labor. So serious is this condition that the head of one of the largest construction firms in the East stated that he has avoided taking new contracts for six months, and will continue to do so until a change occurs.

WAGE ADVANCES EXTEND OVER WEST

It will be noted that the area of wage advances has extended over the whole northern portion of the country during the past six months. F. W. Weymouth, chief of construction of the United States Reclamation Service, reports that a labor shortage is now noticeable on all projects of the service west of the one hundredth meridian (running through Iowa and the Dakotas), excepting those in the extreme south, where Mexican labor is available. On the North Pacific Coast unprecedented shipbuilding activity has cut seriously into the supply of construction labor, wages have advanced materially and unrest is prevalent.

MUCH NEGRO LABOR HAS LEFT SOUTH

Even in the South, the labor supply is fast being depleted. Negroes are reported to have come north by the thousands. Officers of James Stewart & Company, Inc., report difficulty in securing sufficient labor as far south as Norfolk on the Atlantic Coast and Oklahoma in the West. Prosperity has just struck the South, which depends largely on agriculture. From last year's cotton crop, sold at record prices, will be realized the money to finance operations on a scale which was possible for other sections last year. It will not be a surprise, therefore, to find wages advancing and conditions growing more serious in this section during 1917.

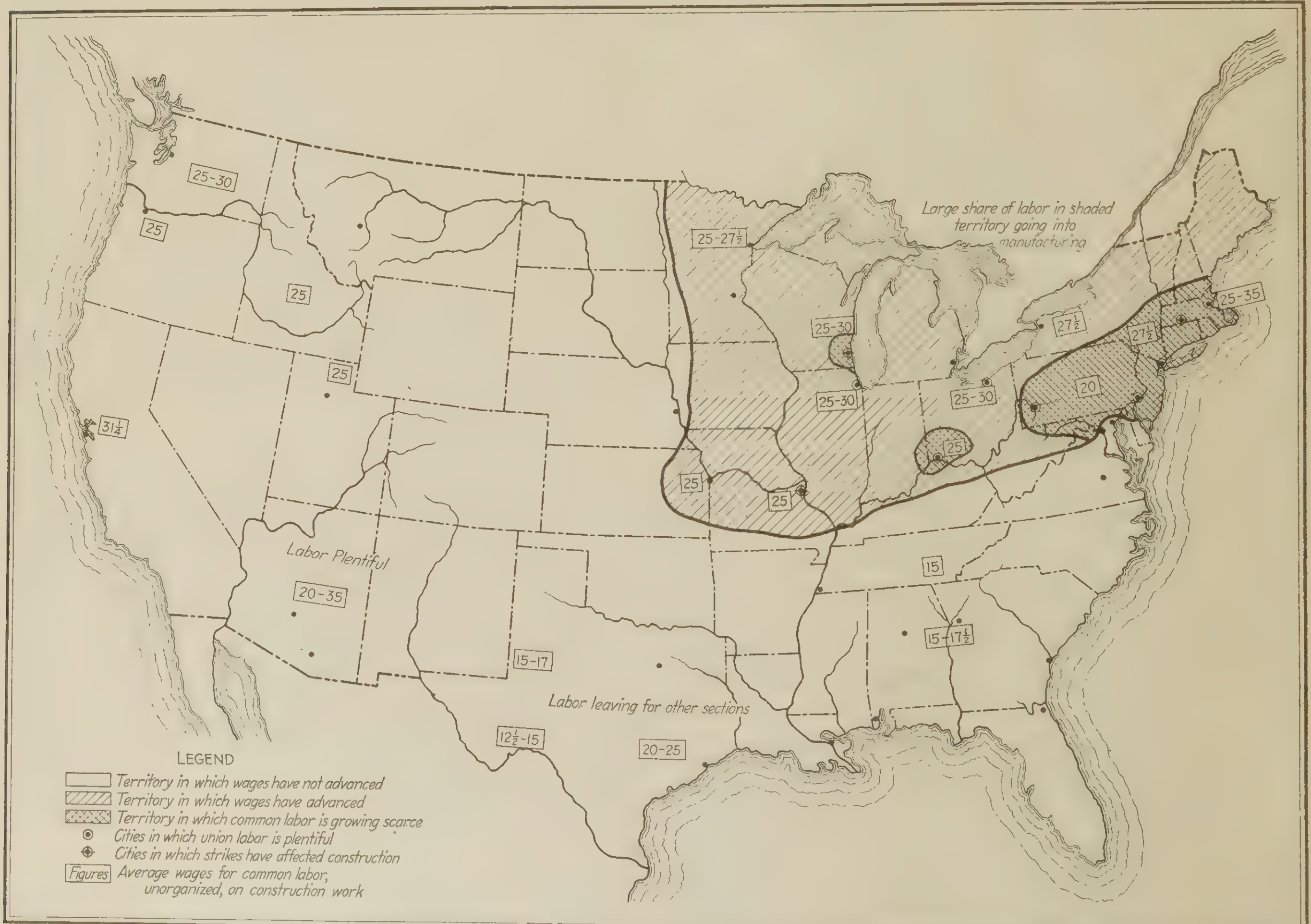
Only in Texas and the extreme Southwest have labor conditions remained unchanged. However, affairs in these border states hinge to some extent on the final outcome of the Mexican tangle, and it is possible that when these troubles are adjusted commercial development will set in on a scale requiring considerable construction. It must not be forgotten that even these states have lost labor to other sections.

Labor Less Efficient

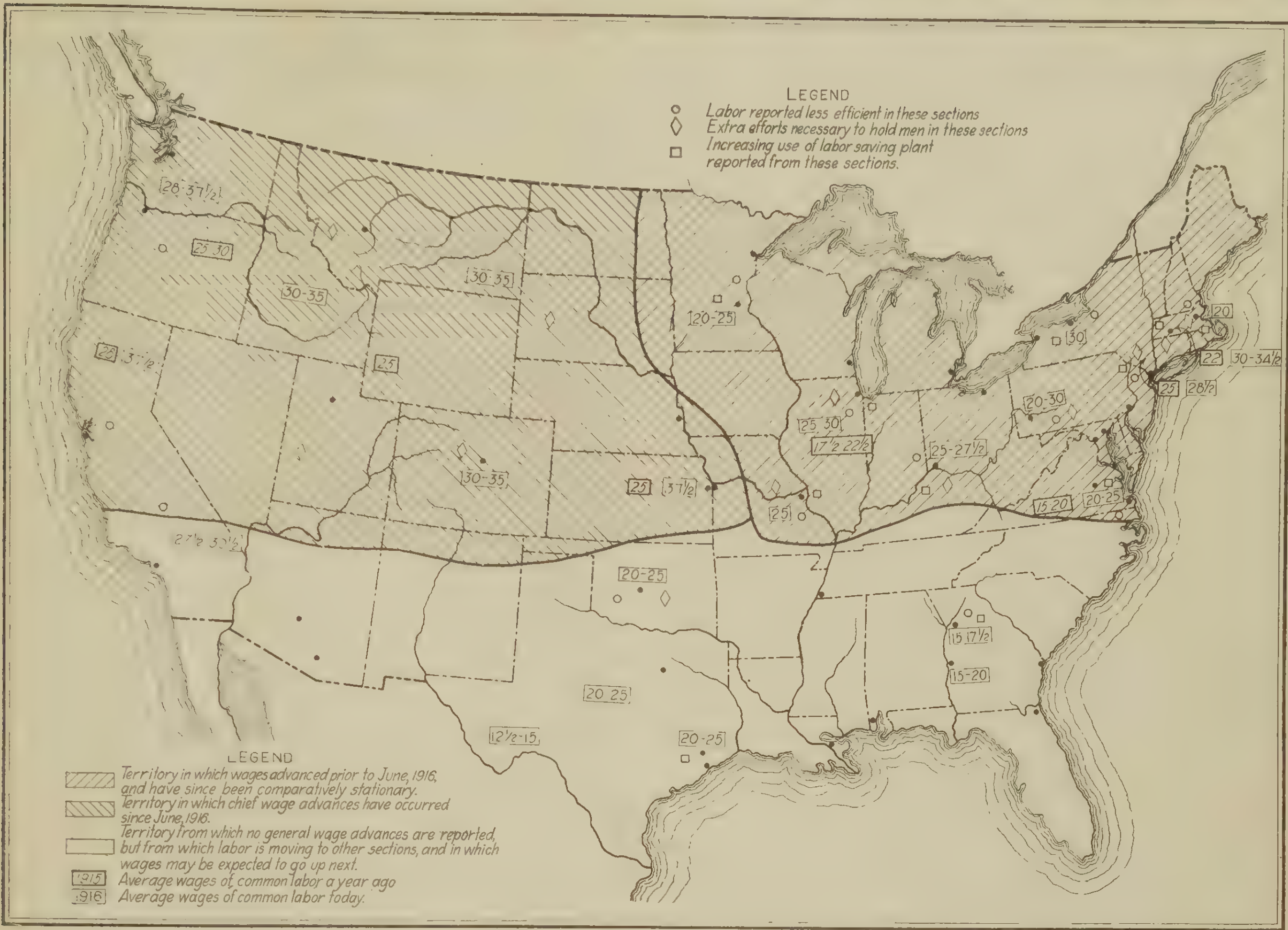
The effect of the situation on the efficiency of construction labor is pithily summed up by A. B. Greensfelder of the Fruin-Conlon Construction Company, of St. Louis, in the statement, "Available common labor is less skilled than formerly and skilled labor is less common." Almost without exception the large operators have found the same trouble. Because of a short and inferior supply of labor, men like J. W. Rollins of the Holbrook, Cabot & Rollins Corporation, H. C. Turner of the Turner Construction Company, W. P. Anderson of the Ferro-Concrete Construction Company, W. A. Rogers of the Bates & Rogers Construction Company, W. O. Winston of the Winston Brothers Company and I. G. Harmon of the Thomas-Harmon Company have reported that on construction work under their charge and observation the use of labor-saving machinery is on the increase. Several of these men and others in charge of organizations of similar size have gone further and stated that construction plant is being used to the fullest extent, and new contracts are being planned with the greatest care to reduce manual labor to a minimum. Of course, with firms engaged in building construction, as is brought out in replies from L. J. Horowitz of the Thompson-Starret Company and G. H. Hailey of the Cleary-White Construction Company, little improvement in this direction has been possible. The leaders in the building field have long planned all their operations with the best skill available, and seized on each new development in labor-saving plant as fast as its worth was demonstrated. Yet men in the front rank of this class of contractors are even now seeking new economies and scanning every horizon for developments that might be utilized with increased efficiency.

Men's Welfare of Growing Importance

Such efforts on the part of the leading minds in the construction realm to increase, even under adverse conditions, the ratio of finished work produced per unit of capital and effort invested are among the most hope-


25-30
25
25
25
31½
Labor Plentiful
20-35
15-17
12½-15
Labor leaving for other sections
20-25
15
15-17½
25-27½
Large share of labor in shaded territory going into manufacturing
25-30
25-30
25-30
25
25
25
27½
27½
25-35
20
Legend
Territory in which wages have not advanced
Territory in which wages have advanced
Territory in which common labor is growing scarce
Cities in which union labor is plentiful
Cities in which strikes have affected construction
Figures Average wages for common labor, unorganized, on construction work

PRESENT LABOR CONDITIONS SHOWN ON MAP ON NEXT PAGE WERE FORESHADOWED LAST MAY


LEGEND
○ Labor reported less efficient in these sections
◇ Extra efforts necessary to hold men in these sections
□ Increasing use of labor saving plant reported from these sections.
LEGEND
▨ Territory in which wages advanced prior to June, 1916, and have since been comparatively stationary.
▧ Territory in which chief wage advances have occurred since June, 1916.
☐ Territory from which no general wage advances are reported, but from which labor is moving to other sections, and in which wages may be expected to go up next.
1915 Average wages of common labor a year ago
1916 Average wages of common labor today.
26 37½
25 30
30-35
30-35
22 37½
25
30-35
20-25
30
20
22
30-34½
25
28½
20-30
25 30
17½ 22½
25-27½
25 37½
25
15 20
20-25
27½ 37½
20-25
15 17½
15-20
20 25
12½-15
20-25

LABOR SHORTAGE HAS EXTENDED OVER ALMOST ENTIRE COUNTRY—ONLY IN SOUTH HAVE WAGES REMAINED THE SAME AS BEFORE THE WAR

Were this map conventioned in the same way as that on the opposite page, the double-hatched area in the latter map would now cover most of the area shown hatched in the map above. Only in Texas and in the white area west of it is the labor situation at present such as to cause contractors no anxiety.

ful signs in the field of engineering. Of first importance in this connection are measures, forced on some and eagerly sought by others, for conserving and improving the efficiency of the working force. As many can testify to their sorrow, a general rise in wages tends to produce a directly opposite effect. Neither can the necessity for paying men's carfare to remote work, or for declaring more frequent paydays, reported by a number as now necessary to hold labor in their territory, be regarded as unmixed benefits. Better-conducted camps, however, such as the United States Reclamation Service has resorted to in an effort to increase the steadiness of its labor force, are bound to react favorably. Systematic efforts to give workmen continuous employment, even though forced on some contractors by the fact that men laid off are men permanently lost, certainly tend to raise the standard of efficiency.

One eastern operator, unable to secure timber men on a bridge contract, put experienced foremen on the job in the proportion of one to each two or three workmen, and has carried out the timber construction in this way with common labor. Action such as this—and other instances could be given—results in training a large number of men who in normal times would learn little more about the work on which they were engaged than how to push a wheelbarrow. It pays now to retain the man that two years ago would have been dropped as worthless and to try to teach him something. The process may be painful to the instructor, and some immediate loss in efficiency can hardly be avoided. But when the present rush is over the construction business will probably emerge with a larger and better-trained force of workers, and an efficiency will be possible which will make up in the long run for present troubles.

THIS YEAR'S WORK TO TAX LABOR SUPPLY

Most of the contractors who replied to the inquiry hold that the labor shortage has already curtailed work and may be expected to have a more serious effect this year. Those who do not voice this opinion virtually agree with it by citing increased material costs and the difficulty of securing deliveries as factors in reducing the volume of construction. Both of these conditions, of course, are due in large measure to the general labor situation, of which the shortage in the immediate construction field is merely another result. While manufacturing plants are able to pay present prices for construction, and real estate operators are finding themselves in the same position, the railroads may continue to hold back. On the whole, however, as much construction work as can be carried on with the labor available is expected to come out in 1917.

Expanding Export Trade Emphasizes Need for Adequate Water Terminals

Public Ownership of Waterfront Essential—Factory and Warehouse Facilities, as Well as Rail Connections and Truck-Loading Space, Must Be Provided

By B. F. CRESSON, JR.
Chief Engineer, New Jersey State Board of Commerce and Navigation

THE EXPORTS of this country have increased tremendously during the European War and the indications are that our present foreign commerce will not only be maintained after peace has been declared, but is likely to increase. The factors which lead to this conclusion are the great number of new industries being created, and the expansion of old industries; the better industrial plants and equipment convenient to tidewater; the better organization of terminals; the better banking arrangements between this and other countries, and the general commercial exhaustion of Europe as a result of the war. With this expanded trade, the development of better railroad terminal systems at the principal harbors of the United States and the creation of more efficient and economic water terminals are of the very first importance to the United States.

Owing to the increased demand abroad for American products there has been a very marked tendency recently for industries to locate near the seaboard where exports can be made with as little delay and expense as possible. It is significant to note that in the State of New Jersey during the year between Nov. 1, 1915, and Oct. 31, 1916, the state was besieged with applications for its waterfront and during that year sold or leased frontage devoted exclusively to commercial and industrial enterprises amounting to more than $506,000, far exceeding the sales of any preceding year.

The recent organization of a great international corporation for the extension of American industries and American shipping throughout the world and for the creation of terminals in this country is a further indication of present tendencies. The increase in American shipbuilding is another activity which points to the extension of the commerce of this country. During the first eleven months of 1916 the merchant ships built in the United States totaled more than double in tonnage the whole year's output in 1915.

WATER TERMINALS

The value of transportation systems to a community is measured largely by the terminal facilities. A railroad passing through a district is of no advantage to that district unless freight and passenger stations and sidings are provided. A waterway or a canal is valuable to a community as a means of transportation only when bulkheads or wharves are provided against which boats may dock. Terminals in congested areas are the expensive parts of the railroad systems, and the expense at some of the principal railroad centers in the country is increasing rapidly and is a great burden upon the finances of the railroads.

In the absence of a joint terminal system in a community, the railroads are developing individual terminals, the best that they can possibly provide in order to attract business to their lines. Competition in rates has been eliminated and competition in terminals at important centers is the greatest competitive condition that remains. Where there are individual terminal systems the road with the best can be reached most cheaply by the shippers and can usually, by the larger volume of its business, make quicker shipments and deliveries. These conditions tend to attract business to them.

At tidewater the competition between the railroads for terminals is most keen, and especially is this the situation now when there is so great a volume of export business. Individual terminal systems at seaports are very expensive and the time is not far distant when their increasing expense will drive the railroads to combine on jointly operated terminal systems. This is particularly the case at New York, where one general terminal system, including waterfront facilities and lighterage equipment, with a union belt line would work economy in the cost of operation and in the use of the waterfront.

It has been the policy of some of the railroads owning waterfront at important seaports to build piers and to provide practically free wharfage for ships in order that the railroads might handle the cargo. This is an injustice to other roads not having such piers. It is an injustice to private pier owners, and more than that, it is an injustice to the communities bordering on the waterfront which are building wharves and docks to increase the commerce of the community.

BETTER WATER TERMINALS

Thoughtful men realize that monopoly by private interests of important waterfront is a public menace, and public sentiment is gradually being directed toward the impropriety of permitting the waterfront in congested localities to be manipulated and operated for private profit. The sentiment is, therefore, developing in favor of the ownership by the public of the waterfront and of the waterfront facilities. The waterways are essentially public highways and as such the public is entitled to reach them on reasonable terms and with as great convenience as possible. The value of water terminals to a community is not measured by the rentals which may be received from their use; the convenience and the cheapness of the terminal facilities are of the utmost value in making the port attractive to commerce and thus encourage industries to locate near by and increase the population of the community. This can best be done by eliminating private profit which must be obtained in private waterfront terminals.

The municipality can get its money cheaper than a private corporation. It needs to get only enough return to provide interest on the investment and a sinking fund, and therefore fundamentally it should be cheaper for commerce to be handled through public than through private terminals.

Public ownership does not necessarily mean public operation. An arrangement could be made whereby a publicly owned water terminal might be operated under contract and with public supervision, by a private operating company, which would guarantee as rental the interest on the public investment, with a provision for profit sharing. This can be conceived as a most efficient and attractive plan.

FOREIGN EXPERIENCE

The public port policy has developed very greatly in Europe, where now at the great seaports the waterfront and the terminal facilities, including the railroads, are usually publicly owned and controlled and often publicly operated. This lesson has been learned slowly, and it was not until 1908 that London, which has been for centuries the greatest seaport in the world, finally determined that it must terminate the private ownership and operation of its docks and terminal facilities, or see commerce gradually leave the port and go elsewhere. The Port of London Authority was therefore created by Parliament and was given more than £27,000,000 to take over the privately owned waterfront and terminals. It was given full power to operate the docks and the accessories, and the plants of the private corporations, such as the London & India Docks Company, the Surrey Commercial Dock Company, the Millwall Dock Company and some others were bought out and taken over by the port authority and are being operated as a public trust. We are gradually coming to a realization of the situation in this country.

There is need in this country, especially at the Port of New York, through which passes more than half of the foreign commerce of the United States, for better water terminals in order to facilitate the exchange of commodities between land and water carriers. There are but few instances in the large American ports of properly designed, built and operated terminal facilities. The expense and the delay as well as the confusion of transshipping of commodities between rail and water carriers have been largely responsible for the blockades of freight and for the embargoes. This condition has hurt everyone, the railroads, the ships and the shippers.

PROPERLY ORGANIZED WATER TERMINAL

A water terminal is a good deal more than a pier and a shed and a railroad track. To be thoroughly economic it must provide sufficient wharfage to accommodate a considerable number of ships, in addition to lighters and barges which are incident to business in a harbor. There must be sheds for the protection of cargo in transit, where cargo may be assembled in advance of the arrival of ships and where cargo from the ships may be held awaiting transportation inland. There must be warehousing accommodations convenient and accessible both to the railroads and to the ships. These are necessary, as it develops that some freight must always be held for a considerable period awaiting a favorable market or for some other reason.

Railroad facilities are of the greatest importance in a water terminal and a sufficient railroad yard must be laid out near the entrance to this terminal to which access can be had at reasonable rates from all the railroads doing business in its territory. From this yard rails must lead to the bulkheads, where the interchange of cargo may be made with ships, and the rails must also lead to warehouses, to local freight stations and to industrial buildings. The greater the volume of railroad freight in any terminals the greater will be the dispatch with which shipments can be made. Where there is a great volume of freight there is not the necessity for holding it awaiting cars for destination.

AUXILIARY FACILITIES

Cold-storage facilities should be provided to take care of perishables in their exchange between rail and water carriers. There should be sufficient upland available so that industries can take advantage of the proximity to water and rail transportation and to the markets of labor and materials which are normal to important terminal points.

In a harbor such as New York, with its parts split up by waterways and with the lack of intercommunication by rail between its boroughs, a clearing house for freight should be provided where freight that is to be or has been lightered may be received and classified and sent away without congesting other parts of the terminal.

Where a terminal is near a great industrial center the motor truck must be taken into consideration and a clearing house should be provided to handle the motor-truck business very much along the same lines as a railroad handles its business through its classification and assembly yards.

A well-designed water terminal should include also facilities for a public market, where produce, meats and other food products can be received in bulk, either by rail or water, and can be distributed direct to the consumer. This would eliminate the middleman to a marked degree.

As a general proposition, the bigger the water terminal and the more facilities it possesses the better and more economical will be its operation.

DESIGN AND CONSTRUCTION

In the proposed marine terminals at Bayonne and at Camden, N. J., which the writer has designed, multiple-story sheds have been placed along the bulkheads at certain intervals in the Bayonne layout, and along most of the bulkhead in the Camden layout. In the particular plans mentioned, the structure has three stories, the first or lower floor being for the handling of cargo in transit between ships, railroad cars and trucks, and the second and third floors for the longer time storage of commodities: it is located alongside of ships and with direct access, through elevators or hoists, to railroad cars and trucks.

With such an installation it seems that material economies may be effected, especially in the saving of drayage between the carriers, either land or water, and the warehouses. Here is a combination of land and water transportation and of long and short-time storage and warehousing within one unit.

Multiple-story structures along the waterfront and on piers are believed to possess substantial advantages and will, no doubt, be resorted to specially in localities where the waterfront is very expensive and where a large volume of cargo is handled. It is not believed that more than three or four stories would be feasible, especially on a pier structure extending out into the waterway. The congestion at the shore end of such a structure would probably be excessive with more than three or four stories, and the question of foundations might be difficult.

SUBSTRUCTURE

General types of construction are governed largely by the locality and the general form of the terminal. Massive masonry or concrete bulkhead walls may be constructed; timber bulkheads with bulkhead platforms may be used or structures may be built entirely on piling. In localities where the marine borers are not active, as in the principal parts of New York harbor, untreated timber-pile structures appear to be the most economical, the life of untreated piles on the North River being from 20 to 30 years.

In localities where marine borers are moderately active the writer favors timber construction, with the timber creosoted where it will be difficult and costly to renew it. There are certain localities where the activity of the marine borers is such that timber even though well creosoted or protected cannot be depended on for any length of time, and at such places consideration must be given to the use of masonry or concrete.

Masonry makes a splendid job, although its lack of elasticity may be considered a disadvantage, and it is very expensive.

Reinforced-concrete dock work is expensive and there may be the danger (unless the design and carrying out of the work are first class) of disintegration through cracking under the impact of heavy vessels, especially in cold climates.

The elasticity of a timber structure where heavy boats are to dock is an important factor in its favor.

The question of fireproof construction of pier sheds and buildings for the storage of cargo on the waterfront is an important one, but it seems unwise to spend much additional money for fireproof construction. The highly inflammable character of much of the commodities which pass over the waterfront makes it seem more desirable, instead of attempting to construct fireproof buildings, to install a full and complete system of automatic sprinklers. A pier shed acts much like a chimney in case of a fire and it is the cargo that burns.

CONCLUSION

The writer is strongly of the opinion that the seaports of this country must build water terminals of more economic design and of greater business scope and capacity than those which have been built in the past; that it will well pay communities to do this, because of the commerce which will be attracted by better and cheaper facilities; that jointly operated terminals must be substituted for the expensive individual systems now operated by the railroads at important centers; that the policy of public ownership of terminal facilities must be extended, thereby cheapening their operation; that public moneys freely spent on carefully thought out terminal plans will pay the communities the investment many times over by the increase in population and industries, with the consequent increase in rateables.

Activated-Sludge Process of Sewage Disposal Firmly Established

Experimental Work Has Solved Most Problems—Sludge Dewatering Still an Economic Problem—Enforced Supervision of Plants Augurs Well for Engineers

By T. CHALKLEY HATTON
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ENOUGH has been learned about the activated-sludge process of sewage disposal to warrant certain municipalities in seriously considering this process and comparing its results with other processes now in common use before a choice is made. To expect that it will take the place of all other processes for treating sewage is a mistake. Standard of effluent required and economic conditions in each case will be the deciding factors in making the choice. These may be favorable to the activated-sludge process in the small as well as in the large municipality, although the latter will always have the advantage because sufficient sludge will be produced to warrant the cost of the reduction to a fertilizer, whereas in a small plant this cost may be prohibitive.

In making any choice, however, these facts must not be overlooked—that in all processes of sewage treatment where tanks are used the disposition of the resultant sludge is a constant and ever-increasing nuisance and expense; that the activated-sludge process produces a sludge which is far more valuable as a fertilizer than any of the well-known processes, and that there is ample market available for it when reduced to proper form.

LOCATION OF PLANTS

During the year just ended considerable progress has been made toward solving the problems connected with the process. Important experiments have been carried on at Urbana, Ill.; Lawrence, Mass.; Baltimore, Brooklyn, Cleveland, Regina, Sask.; Toronto, Milwaukee, Armour and Swift, and the Sanitary District of Chicago. Besides these, investigations have been conducted in a more or less systematic manner by the boards of health of several of the states.

An activated-sludge treatment plant having a capacity of about 1,500,000 gal. per day has been built at Escanaba, Mich. The septic tanks operated for many years at Champaign, Ill., have been improvised into an activated-sludge plant to treat about 500,000 gal. daily. Regina, Sask., has a plant in operation treating a part of its sewage, and the largest plants, one capable of handling 12,000,000 gal., and the other 6,000,000 gal. per day, are now being built at Houston, Tex. A plant for treating the sewage of Lima, Ohio, during the summer months has been recommended, and one for treating the sewage of Mattawan, N. J., has been designed and approved. Milwaukee is now engaged in designing a plant for treating 130,000,000 gal., normal flow, per day.

WHAT HAS BEEN DETERMINED

From the evidence to date it appears that this new method of treating sewage has aroused widespread interest in America, that it has come to stay and that, if tanks are properly designed to meet conditions favorable to the process it will place the problem of sewage disposal in a more satisfactory situation than it has heretofore attained.

Considering the problem from the viewpoint of the average municipality, many of its phases have already been solved, others more or less satisfactorily, and some not at all. It has been proved beyond any doubt that the aëration of raw sewage in the presence of well-activated sludge for a certain length of time will separate the suspended and colloidal matters, induce rapid precipitation and produce a clear, non-putrescible effluent. The character of effluent produced depends on the character of influent, the volume of air applied, the period of application, the temperature of sewage treated, and upon the period and method of sedimentation.

A clear and non-putrescible effluent can be produced at rates of from 7,000,000 to 10,000,000 gal. per acre per day, including all area needed for aëration, sedimentation and sludge-settling tanks.

The process produces a sludge containing from 4 to 6 per cent of available ammoniacal nitrogen, which has sufficient value as a fertilizer base to warrant the cost of its reduction, and the volume of such sludge produced depends on the amount and character of the suspended matters in the raw sewage. Neither flies nor objectionable odors are produced by the process.

LIME NOT NECESSARY FOR DEWATERING

The sludge can be successfully dewatered by more than one method, without the addition of lime, reduced to fertilizer base and disposed of at a net cost, at most no greater than the cost of disposing of sludges produced from other treatment processes. There is ample market for the sludge when reduced to a fertilizer base.

Satisfactory diffusion of the air through the sewage can be accomplished by at least three methods: (1) Through perforated pipes laid in the form of grids near the bottom of the aërating tanks; (2) through Filtros plates built into the bottom of the tanks, and (3) through wood plates made up from porous wood about ½ in. thick and sawed cross-grain.

Sedimentation is effected in from 40 to 50 minutes' detention period in either vertical or horizontal-flow tanks, or by a combination of both.

While there are many other interesting features already solved, the ones enumerated are perhaps the most important. The following features are not yet satisfactorily determined, although considerable investigation is going on to that end:

1. What influence the depth of liquor in the aërating tank has upon the volume of air and period of aëration required.

2. The most economic method of diffusing the air through the aërating tanks and the influence baffled tanks may have upon the aërating process.

In this connection it might be well to state that it has been satisfactorily demonstrated that Filtros plates do not become stopped up on the under surface provided the air delivered is kept free of oil and dust. These foreign matters can be eliminated by washing the air before or while it passes through the blower and by installing a type of blower which excludes all oil from inside the blower casing.

AIR REQUIRED PER GALLON

The present evidence indicates that it requires from 1.5 to 2.0 cu. ft. of air to treat a gallon of sewage containing 325 parts of suspended solids per 1,000,000 gal. in a tank carrying 10 ft. depth of liquor, when the sewage has a temperature of 50 deg. Fahr. and upward. Below this temperature about 50 per cent more air is required. Cleveland is procuring a clear effluent from sewage containing about 250 parts of suspended solids by using from 0.7 to 0.9 cu. ft. of air per gallon of sewage in a tank carrying 15 ft. depth of liquor.

It is felt by those engaged in studying intensely the air problem that a large reduction in air requirements will be possible with improvements in diffusers and tanks.

What economic advantage can be secured by aërating the activated sludge before returning it to the aërating tanks is a matter not yet determined. Cleveland is experimenting upon this feature now. The Houston plant has been designed to reaërate the sludge through about twice the period that the sewage is to be aërated.

TYPE OF SEDIMENTATION TANK

The proper type of sedimentation tank is still problematical. Experiments so far indicate that surface area and depth have little influence. As soon as the mixture of liquor and sludge becomes quiescent the latter rapidly flocs and settles at the rate of about 1 in. per minute. The lighter particles of this floc are so near the specific gravity of the liquor that any cross-currents accelerating the velocities in the sedimentation tank induce them to rise and again mix with the liquor; so that it appears to be highly important to maintain a uniform velocity through the tank. Horizontal velocities of 3 ft. per minute and vertical velocities of 8 ft. per hour have been found satisfactory.

The disposal of the resultant sludge has been one of the most vital features of the problem and has been studied in greater detail at Milwaukee and Cleveland than at any other points. While it has been satisfactorily demonstrated that this sludge can be dewatered by several methods the most economic one, and its cost, is still to be determined.

At Cleveland the dewatering has been done by a centrifuge of the inclosed laundry type, and also by drying on beds inclosed in glass roofs, the residue being destroyed by incineration. The cost has not been determined.

At Milwaukee the moisture content has first been reduced from 99 to 96 per cent by settling 1 hour or more, then further dewatered to 75 per cent moisture by pressing through a Berrigan filter press and a Simplex plate press, the former manufactured by H. R. Worthington of Harrison, N. J.; the latter by the Simplex Ejector Company of Chicago.

FOUR TONS OF SLUDGE CAKE PER DAY

Either of these presses will produce about 2000 lb. of cake in 5 hours, or about 8000 lb. per day of 24 hours. The sludge is easily handled, has no objectionable odor and can be stored without nuisance.

The sludge cake has been further dewatered to contain from 5 to 12 per cent moisture by means of either an indirect steam dryer of the Smith type or a direct heat dryer of the Buckeye type, after which it is ground up to seeding size by either the Williams or Stedman mill. The amount of cake thus dewatered depends upon the type and size of dryer used.

Other methods of dewatering the sludge are being investigated and with great promise. The most expensive portion of the dewatering process, as carried out in Milwaukee, is the pressing to reduce the moisture content from 96 to 75 per cent. This expense embraces labor, filter bags and large overhead. If the Dixon yeast process, as now being tried out in Brooklyn under the inspection of George W. Fuller, proves economical in reducing the moisture to at least 85 per cent, the material can be further dewatered by a direct heat dryer, without pressing, at much less cost. Cattle manure, containing from 85 to 90 per cent moisture, is being very successfully and economically dewatered at Armour & Company's feeding stations at Peoria, Ill., and at St. Louis by the Buckeye direct-heat dryer.

SLUDGE COSTS AND VALUE

The cost of dewatering the sludge depends upon several factors—the size of plant, price of fuel for drying, power costs and the cost of labor. At Milwaukee, where an average of 40 tons of dried material will be produced per day, the cost of dewatering, grinding and storing, if the apparatus already experimented with is finally used, will be from $6 to $8 per ton, based on a final product containing 10-per cent moisture. This cost includes all overhead charges, such as interest, sinking fund and depreciation, not only upon the apparatus, but upon the buildings required for their housing.

The market value of the ammoniacal nitrogen in the sludge ranges from $1.75 to $3.50 per unit, or from 8¾ cents to 17½ cents per pound. The Milwaukee sludge averages 4½ per cent of available ammonia after the drying process has been completed. Therefore it appears that if the cost of reduction is the maximum and the value is the minimum the sludge can be disposed of without cost to the city. On the other hand, if averages are used in both cases a net profit of approximately $5 per ton will be realized for the city. In either case the results will be a great step forward in the art of sewage disposal.

The cost of constructing an activated sludge plant will vary according to local conditions. Three complete plants are now in course of construction.

The Escanaba plant will cost, according to present contracts, $40,000, including sludge reducing apparatus, or $27,000 per million gallons. The conditions under which this plant is being built are rather unusual. The excavation is being made through water-bearing sand, there being a static head of 24 ft. upon the bottom of the excavation, thus increasing the cost materially. The estimates for the two Houston plants were $128,000 and $250,000 respectively. The present contracts, which embrace the building of all the tanks, piping, etc., but not the machinery, call for an expenditure of $82,602 and $186,549 respectively, or about $13,100 and $15,500 respectively per million gallons. Estimating power and machinery worth $60 per horsepower, and sludge presses and dryers with transmission equipment at $7000 per million gallons, the total cost of the Houston plants will be approximately $22,200 and $24,600 per million gallons, exclusive of land and engineering.

Careful estimates have been made of the 130,000,000-gal. plant for Milwaukee. These indicate a cost of $25,000 per million gallons, which includes buildings and sludge reducing plant and excludes land and engineering. This plant is to be built into the lake upon pile foundations, thus making the cost unusual.

AIR COSTS

The largest share of the operating cost of the process is represented by the amount of air used. This depends upon the cost of power, which varies largely throughout the country. In making estimates for the cost of air it appears to be safe, from present knowledge of the process, to allow for using 2 cu. ft. of air per gallon of sewage treated compressed to 6 lb. pressure when using 10 ft. effective depth of water in the aërating tank, and basing the volume of air required upon the daily average flow of sewage plus from 5 to 10 per cent for sludge air-pumps.

The percentage of activated sludge kept in contact with the liquor during the aërating period may vary from 15 to 25 per cent without seriously influencing the process. The adaptability of the process to local conditions is perhaps greater than any other yet discovered because any standard of effluent can be produced by varying the volume of air, the period of aëration and the volume of activated sludge.

PROCESS FORCES SUPERVISION

Intelligent supervision of operation is to be desired to get the most economical results. This feature should commend the process to the members of the engineering profession engaged in sewage-disposal problems and management. They appear to be convinced that the successful operation of a sewage-disposal plant, no matter what process is installed, requires as careful supervision as water purification or garbage disposal.

It is a fact well recognized by engineers who have opportunities for visiting the sewage-disposal plants for small municipalities throughout America that few of them are producing an effluent anywhere near the standard for which they were designed or could produce under competent supervision. This condition is largely due to the tendency of engineers to build works which might be expected to operate automatically. The character of the average sewage is too complex to do this successfully. The existing conditions are vividly portrayed in the recent report of the committee on sewage-works operation of the American Public Health Association. It appears that of the 1294 sewage-disposal plants reported to the committee only 61 were supplied with the necessary equipment and trained men for proper operation; and, while each of the 48 states had boards of health which should have the legal power and trained men to require sewage-disposal plants to be operated to meet the purpose for which they were built, only 15 states in the Union were endowed with such powers. . . . .

To quote from this report, one correspondent states, "Our municipal sewage plants have practically no supervision either by the state board of health or by local authorities . . . . . . We have even found cases where local authorities were doubtful as to the location of the plant." . . . .

Under such conditions is it any wonder that sewage disposal in the United States has been a record of disappointments and failures? And is it not high time for engineers to realize that a necessary requisite for all plants is continuous and enforced competent supervision?

The activated-sludge process requires certain moving machines, and thus becomes comparable to a municipal water plant. Every municipality gives fairly good attention to its water plant not only to secure as good water as possible, but to protect its high-class machinery. Sewage disposal by this new process will, for like reasons, enjoy competent supervision, and to that extent at least is an improvement upon most of the present methods of sewage disposal.

The experimental work now being conducted cannot be expected succcessfully to solve all the problems connected with the process. It has solved what might be considered the basic features, but, like all other newly discovered arts, perfection can only be attained by actual development of working plants under varied conditions.

The Motor Truck and the Road

Vehicle and Highway Must Be Considered as One Problem—Indications Are That 6-Ton Load-Carrying Capacity Will Be the General Maximum

By NELSON P. LEWIS

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HUNDREDS of millions of dollars have been expended and many millions more will be spent within the near future in the improvement of roads in urban, suburban, and rural districts. The demands for road improvement have been greatly stimulated by the change in the character of vehicles using these roads, and much study is being devoted to the problem of the adaptation of roads to the character of vehicles using them, while some consideration, but not enough, has been given to the adaptation of the vehicles to the roads. Painstaking investigation as to the character and use of road material is important. Improvements in the type of vehicles which are to use our highways, in order that the cost of maintaining the roads as well as that of transportation on them may be reduced to a minimum, are also important, but these are so closely related that they may be considered two phases of a single problem. They are intimately connected and should be studied together, while careful consideration should also be given to intelligent regulation of traffic in order that the general public may receive the greatest possible benefit from the investments already made and yet to be made in highway improvement, and in order that this investment may have the greatest possible permanent value.

Attention is now being given to weight of vehicles, to their length and width so far as they affect the use of roads, and these are the factors it is proposed to discuss in this article.

The type of construction which generally prevailed a decade ago, when roads were chiefly used by horse-drawn vehicles and by relatively few motor vehicles, and these for pleasure traffic, is not suited to the traffic to which roads are now subjected. They must not only be provided with a surface adapted to fast-moving motor vehicles, but they must also have sufficient strength to carry the loads imposed upon them by commercial vehicles or motor trucks. They must also be of such width as to accommodate the increased size of vehicles of the latter class. While the need of substantial pavement foundations in city streets, which were likely to be subjected to very heavy loads, has long been recognized, rural highways are now called upon to carry loads which approximate those heretofore found only in populous centers.

GREAT INCREASE IN STREET TRAFFIC

The volume of traffic on city streets has greatly increased of late, and it has frequently been stated that the capacity of our city streets would have to be increased either by the widening of roadways or by the creation of new thoroughfares. The trouble has been that traffic has not been well distributed. There is undoubtedly an enormous surplus area of pavement in all cities, but, while certain streets are greatly overcrowded, others are almost deserted. This is due to two causes, namely, the persistence with which traffic will follow a route once established and with which drivers are familiar, and the lack of generally well-paved streets. If the latter trouble were remedied, the former difficulty would soon solve itself. While this is true with respect to both pleasure and commercial traffic, it is conspicuously the case with respect to the former, as additional distance is of little moment to the driver of a pleasure vehicle who would gladly go half a mile or a mile further if by so doing he could follow a more agreeable route, both with respect to pavement surface and attractiveness of surroundings. It is with the commercial traffic or the motor truck that this discussion will deal.

WEIGHT TENDENCIES OF TRUCKS

The increasing weight, load capacity and size of motor trucks have been matters of grave concern to all who are responsible for the construction and maintenance of public highways. While numerous instances could be cited of excessive and unreasonable loads, for the support of which the public should not be called upon to make provision, let us see what is the tendency in this respect at the present time.

The increase in the number of commercial vehicles is obvious to the most casual observer. The registration of such vehicles in the State of New York during the three months following Feb. 1, 1916, exceeded the total registration for the year 1915. The review published in the *Commercial Vehicle* early in 1916 indicated that there were no less than 221 manufacturers in this country who are offering vehicles of this kind. Of this number, 133 appeared to confine themselves to those of less than 3 tons capacity. Of the remaining 88, 58 appeared to have made no changes in the maximum capacity of their models for 1916. In 44 cases the maximum capacity was 5 tons or less. Nine of the manufacturers offered trucks of a maximum capacity of 6 tons, one 6½, one 7 and three 7½ tons. Twelve of the manufacturers increased the maximum capacity of their trucks, only two of them, however, reaching a maximum of 6 tons. On the other hand, six manufacturers decreased the maximum capacity of the truck offered, one of these from 6 to 4 tons and another from 7½ to 5 tons. The list indicated that there were twelve newcomers in the field, of whom but two offered trucks with a maximum of 5 tons and one with a maximum of 6 tons. The popularity of the 3½-ton and 5-ton trucks is evident from the statistics, a number of manufacturers having adopted them as their maximum.

Six of the largest makers of motor trucks, one organization dealing with the technical problems of their design and one devoting itself to the promotion of their use have given the writer their opinions as to the probable economic limits of weight of truck, load capacity and load on rear axle. The maximum weight of truck is estimated at from 10,000 to 12,000 lb., the load capacity from 10,000 to 16,000 and the load carried on the rear axle from 16,750 to 24,000. The load per inch width of tire is estimated at from 600 to 800 lb.; and it is noted that this limit is due to the inability of rubber tires to sustain a heavier load, while the effect of concentrated loads upon the wearing surface and foundation does not appear to have been considered.

PROBABLE MAXIMUM

There seems to be a rational basis for the prediction that the maximum limit of truck capacity will be about 6 tons, as a careful analysis of the ton-mile cost of moving material by motor truck indicates that this cost reaches a minimum in the case of a 5-ton truck at a speed of 9 miles an hour or a 6-ton truck at 8 miles an hour. The cost per ton-mile of a 10-ton truck at 5 miles an hour is materially greater, while that of a 1-ton truck at 15 miles an hour is very much greater. All of these estimates appear to have been predicated upon 5 hours of actual running during the day. All the manufacturers who have supplied the foregoing information say that there will be special cases where heavier loads could be carried advantageously if the state or city regulations will permit, and all estimate the speed capacity of trucks to be considerably above that which is most economical, while they state that on well-paved streets grades up to 15 or 18 per cent can be overcome.

WIDTH AND LENGTH

A consideration of the utmost importance, especially in the case of city streets, is the size of the vehicle, more particularly its width. The manufacturers and others whose opinions with respect to loads and speeds have already been referred to have indicated that the wheelbase varies from 12 ft. 6 in. to 17 ft. 4 in. and the overall length from 22 to 28 ft.; that the gage between centers of tires is from 5 ft. 10 in. to 6 ft. 3 in., and the overall width, including load, from 7 ft. 4 in. to 8 ft. It is stated that, while these will be the probable limiting dimensions, special loads, such as plate glass carried flat, may exceed the above cited overall widths in a few instances.

The effect of increasing width of vehicles and loads on curbed city streets will be very serious, as it will tend to reduce the number of lines of traffic which can use them. If a curbed roadway is designed to provide for four lines of traffic and if, as a result of increasing the width of loaded vehicles, it can accommodate but three lines, the capacity of the street will be almost cut in two, as the third line of traffic, being obliged to accommodate vehicles moving in both directions, will be of little use. On rural highways the increasing width of loaded vehicles may not be so serious in its consequences, yet it will retard traffic owing to the danger of passing, while it has already resulted in a tendency to increase the standard width of rural highways from 15 to 16 to 18 and, in some cases, to 20 ft.

TRAILERS

The increase in the use of trailers has caused some anxiety to highway officials. One of the manufacturers referred to has stated that one trailer may be used in city streets, resulting in a total length of truck and trailer of 40 ft. Another expresses the belief that three trailers may be used with a total length, including the truck, of 50 ft. Another notes that with a tractor loads of 15 and 20 tons can be hauled, and with a tractor and two or more trailers the load capacity is limited only by the power of the tractor and the ability of the load to sustain its weight; while still another observes that "it is entirely feasible to construct road trains in which the trailers will follow practically in the path of the tractor, also to have the tractor generate electricity which will be used in driving motors on the trailers, thus making it feasible to operate a road train as long as an ordinary railroad train."

It is probably safe to say that the use of one trailer in city streets and possibly two on thoroughfares that are not congested will involve no serious difficulties so far as the obstruction of the street is concerned, and that on rural highways the number may be increased, though not to the extent indicated in the foregoing quotation. Trailers now are designed to follow the tractor without cutting corners, so that one of the chief objections to their use has been eliminated.

REASONABLE RESTRICTIONS

The need of reasonable restrictions as to the wheel loads permitted on public highways is generally recognized. As already stated, manufacturers of motor trucks have estimated the maximum load per inch width of tire at from 600 to 800 lb. in the case of rubber tires, and such loads will probably have no serious effect upon city pavements or upon rural highways of the type now being constructed in many states, but the steel tire on both truck and trailer, frequently carrying a load per inch width far in excess of that named, is an engine of destruction which has played havoc with many highways.

The great advantages of the motor truck over horse-drawn vehicles and the extraordinary developments which have taken place in its manufacture make it quite evident that it must be reckoned with in the design and construction of our highways. It should not, however, be taken for granted that the adaptation of the one to the other is the obligation solely of the highway authorities, but that the obligation is mutual. In other words, while every effort should be made to provide highways suitable for the use of mechanically propelled vehicles, the manufacturers of such vehicles should devote the skill which they have already shown in their manufacture to adapt them to existing roads and those which are now being constructed. It is necessary that the public authorities should also take a hand in solving this problem and should impose such reasonable restrictions upon the use of public roads as will be necessary for the protection of all road users and of the enormous investment of cities and states in highway improvement. Regulations imposing positive limitations not only upon the total wheel loads and the load per inch width of tire, but also upon the total width and length of vehicles which may be registered, as have been adopted by the State of Pennsylvania, seem reasonable and necessary. Such regulations may also provide for the imposition of a special fee, increasing with the load per inch width of tire and with the total width of vehicle and load, and the justice of such graduated fees can scarcely be denied.

Regulations of this kind, whether they involve the imposition of graduated fees or an absolute prohibition of vehicles having more than specified dimensions or wheel loads, should not be adopted hastily and should not be the result of a guess or of snap judgment. Important elements which should be considered in the framing of such regulations, but which are often overlooked, are wheel diameter and speed. These appear to have been considered in the Code of Regulations now under consideration in New Jersey (see Engineering Record of October 28, 1916), but it is important that they be expressed in a form so clear and simple as to be readily understood.

What Motor Trucks Offer to Contractors

Specialized Gasoline Machines Have Been Developed for a Wide Variety of Construction Purposes—Electric Trucks Need Investigation

By **ARTHUR J. SLADE**
Consulting Engineer, New York City

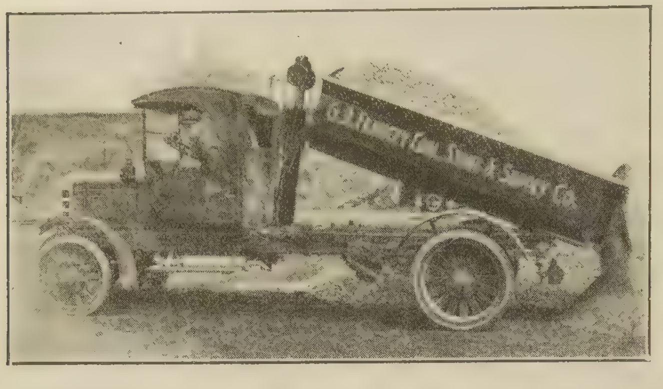
TO the intelligent observer of modern engineering development it may appear surprising how little the engineering construction interests have adopted and used motor trucks. Commercial lines of business have for some years successfully used them in competition with horse-truck, railroad and steamboat service. And yet interests which have the broadest knowledge and fullest experience in the application of mechanical devices have not, to the same extent, availed themselves of this type of equipment. This modern transportation system lends itself to a diversity of applications. It is free from the adverse effects of varying climatic conditions, requires little in the way of plant equipment for its maintenance and operation and can be operated at high pressure for long periods to an extent which is possible in few other transportation methods available for engineering construction operations.

MOTOR TRUCKS FOR CONTRACTORS

The American contractor has a reputation for ingenuity and progressiveness which would suggest his being among the earliest and largest users of such time and money-saving appliances. Why, therefore, is he actually one of the most recent and least extensive motor-truck users?

The answer is not difficult to any one who has been in touch with engineering construction, on the one hand, and motor-truck development on the other. The contractor applies to his operations mechanical and other devices often ingeniously combining comparatively unrelated units in an inventive manner, the result being a peculiarly efficient and suitable combination to perform the work in hand. Few, if any, contractors have designed their own steam shovels, electric plants or concrete mixers, but such individual units, however, have been built primarily for contractors' use. Had trucks, designed and built especially for contractors' use, been offered on the market at an earlier date, their inclusion in the contractor's plant would obviously be more general at the present day.

It should not be concluded, however, that the motor-truck interests were remiss in their recognition of the contracting industry, or that they are only now becoming aware of this great market. The development of the present-day motor truck was fraught with difficulties, obstacles and setbacks which, to put it mildly, were disheartening to many and disastrous to some. As in probably most pioneer developments, both moral and financial courage were required, since the product of the early efforts to produce motor trucks of a prac-



1—SEVEN-TON AUTOMATIC DUMP TRUCK WHICH SAVED ALMOST $1,000 IN TWENTY-FIVE DAYS

2—HAND TRIMMING ON ROAD WORK IS LARGELY ELIMINATED BY THIS METHOD OF SPREADING

tical type was regarded variously with contempt, derision or incredulity. Moreover, it should be recalled that scarcely a decade covers the period between crude experiment and successful achievement and universal recognition. It was quite natural, and in fact practical, for the motor-truck pioneers first to build machines for use in those lines in which the largest market was likely to be found, and to which the experience of the pleasure-car field could be most readily applied. For these reasons vehicles of comparatively light carrying capacity, intended primarily for use on city streets or good roads, were first perfected.

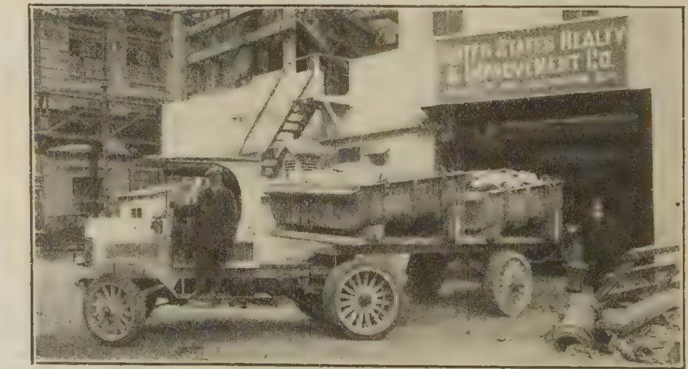
SPECIALIZED MACHINES DEVELOPED

Later the specialized machines were made possible by reason of added experience both in design and manufacture and the introduction of new materials of construction. The adoption of automobile-engineering standards and the manufacturing in quantity of component parts by so-called "parts manufacturers" have also contributed in a large measure to increase in quality with reduction in manufacturing cost, thereby making an investment in motor trucks more attractive by reason of decreased first cost and maintenance expense. Furthermore, the designing engineers, being relieved of some of their responsibilities in connection with the production of conventional merchandise-carrying vehicles, were left more free to originate special machines, parts or accessories especially adapted to engineering operations. To-day an entirely suitable motor-vehicle equipment can be secured from any one of a number of manufacturers which will be adapted to perform its individual functions in full co-operation with the other mechanical units employed in the contractor's plant; but the great variety in engineering projects necessarily suggests the desirability of a wise selection of the motor equipment in relation to type, capacity and general features of design.

TYPES OF TRUCKS

The most extensively used truck in general contractor's service is the gasoline-engine-driven four-wheel machine, propelled by the rear wheels and having a power or hand-operated dumping body. This type of machine is familiar to all, since its use is so general in all classes of business involving handling of material in bulk where quick dumping is desirable, and its economies can be enhanced by providing means for equally fast loading. Capacities at present run up to 7 tons, which is now generally regarded as the maximum desirable capacity for four-wheeled vehicles. The economies effected by the use of these dumping trucks of course vary widely in different localities and under various service conditions, and generalizations would be valueless. Photograph 1 illustrates a Sterling 7-ton automatic dumper operated in Milwaukee. During 25 operating days of 20 hours each in May, 1916, it effected a saving in haulage cost of $985. Photograph 2 shows a similar truck distributing broken stone for road construction in Ohio, hand-trimming being largely eliminated by this method of spreading. It is therefore obvious that it is not always in haulage saving costs alone that these trucks are advantageous. A Garford 6-ton truck at Roxbury, Mass., was put on an excavation job which had become impossible for horses, and the use of the truck rendered unnecessary the installation of hoisting apparatus. Photograph 3 shows a Mack emergency and wrecking truck, just installed

3—EMERGENCY AND WRECKING TRUCK EQUIPPED WITH POWER WINCH AND REMOVABLE DERRICK



6—ON THE NEW YORK SUBWAY WORK PRACTICALLY ALL EXCAVATED MATERIAL IS REMOVED BY MOTOR VEHICLES

4—TRACTOR-TRAILER OUTFIT HANDLING LOAD OF SIXTEEN TONS OF STRUCTURAL STEEL

by the Boston Fire Department, equipped with a power winch, cable, a removable derrick, a drawbar for towing purposes, and other wrecking apparatus and tools. Its construction makes the truck a practical piece of machinery for the contractor, excavator and builder, as the winch can be utilized for hoisting the truck's load to upper floors and for lowering or removing material to and from excavations.

DEVELOPMENT OF TRAILER

When the haulage of loads is in excess of 7 tons per unit, or the character and dimensions of the loads render it desirable, the tractor and trailer equipment is available. Although originally an adaptation of the motor truck, accomplished by mounting the component parts on a chassis frame of reduced length and mounting a fifth wheel on the rear for the attachment of the forward end of a horse-drawn wagon, specially designed machines are now extensively used. Photograph 4 shows such a machine (a Mack tractor with a 16-ton load) handling structural steel. One of the Knox tractor and semi-trailer outfits is of a low-hung type, only 26 in. from the ground, and is designed for cut stone, curbing, machinery, etc. Several companies make a specialty of constructing such outfits for the solution of special problems.

The independent four-wheel trailer is a development of the past few years, and while not designed exclusively for engineering contractors is an extremely useful adjunct either to a four-wheel truck or to a tractor trailer. Photograph 5 shows a Knox tractor trailer and two 4-wheel trailers transporting concrete pipe weighing 20 tons. The heavy loads which the modern tractor is capable of hauling should be so distributed upon a sufficient number of bearing wheels, suitably tired, that no damage will result to the road surface or its foundation. While some outfits may have been built which have an injurious effect on roads, it is possible to construct a machine so that its effect on an improved road will not be destructive. It is equally possible to design equipment which in its operation will make a fair road where none previously existed. The tractor-trailer system is coming to be of the greatest advantage to the contractor, and it would be unfortunate should any ill-advised installations bring it into disrepute.

POSSIBILITIES IN ELECTRIC TRUCKS

The electric storage battery truck has not as yet made great inroads into the contracting field. It is rightly regarded in its commercial aspects as a city truck, but much engineering construction work is carried on in cities, or in localities where the roads are improved. In much of this work electricity is used, and whether purchased from central station or generated in the contractor's plant its cost is probably lower than commercial consumers are obliged to pay. Since the electric truck has shown its decided advantages in so many business installations and has also, in the form of a tractor, operated efficiently in certain specific cases, this type of vehicle should not be arbitrarily ignored in considering an equipment, as an analysis of its possible advantages might prove surprising. The modern high-grade charging and interchangeable battery system has greatly reduced operating costs with

5—TRAILER TRAIN TRANSPORTING TWENTY TONS OF REINFORCED-CONCRETE PIPE an increased ton-mileage capacity. Some tests were recently made with electrics on a material haulage proposition involving loading from hoppers at tidewater and delivering by chutes at several distant points at higher elevations, thus requiring that the trucks should haul their maximum loads up grade, returning down grade empty. The estimated tonnage delivery cost worked out lower than present actual costs with horses and gasoline trucks. Where the cost of current is low the electric should be investigated, even though road surfaces and grades would at first sight seem to render it unsuitable.

GAS-ELECTRIC OUTFITS

A new application of an old system which it is believed can be applied extensively in engineering works is the gas-electric tractor and trailer. In this system a gasoline-engine and generator unit having a greater capacity than may be required for mere haulage purposes furnishes the power plant of the tractor, which is driven by electric motors through a simple standard electric control. The surplus electric power is available for the operation of auxiliary electric motor-driven devices for loading and handling material or other purposes, and these auxiliaries may be located at a distance from the tractor and trailers if desirable. The only prominent application of this system at present is in the "model district" of the New York Street Cleaning Department; but it offers a means for effecting great economies in first cost and operating expense in a contractor's plant.

TIME ELEMENT IMPORTANT

The time element, as well as the reliability of service in engineering operations, is usually of utmost importance; and the fact that the truck is so rapid, reliable and mobile renders it of particular value. As has been shown on the Mexican border, motor trucks of standard types can be readily equipped with detachable flanged tires and run on rails.

Trucks have also been used to haul trains of cars on industrial railways. Roads impassable to other traffic have been traversed by motor trucks by laying wheelways of plank, if for temporary use, or channels or I-beams laid flat on the road surface if for more extended use. As the contractor becomes more and more familiar with the capabilities of the numerous types of motor trucks available he will doubtless exercise his ingenuity by utilizing these units in many ways as yet unthought of, with a saving in time, cost and equipment.

Success in Earth-Road Contracting

Small Capital Encourages Incompetents to Bid—Experience and Good Equipment Necessary If Work Is to Be Done Well and at a Profit

By W. S. KELLER
State Highway Engineer of Alabama

NO FORM of road construction requires as little equipment, and consequently as little capital, as do those roads which are simply graded or surfaced with sand clay or top soil. Ten teams, necessary wagons, wheel and drag scrapes, plow, road machine and harrow, with small tools and camp equipment, are about all that is necessary for a man to have to enable him successfully to carry to completion a contract for such a road. The consequence of this is that there are far more contractors in the South bidding on sand clay, top soil and earth roads than those bidding on macadam or other hard surfaced roads requiring an outlay of expensive machinery. Incidentally, this is one of several reasons why such roads can be built at such a low cost.

Moreover, this fact of low cost of equipment is responsible for a large number of novices going into the contracting business, and coupled with the consequent competition, the failure of many.

"MAKING A SILK PURSE OUT OF A SOW'S EAR"

The engineer in charge of such road construction has many problems, the most difficult of which is making a "silk purse out of a sow's ear," or a finished contractor out of a green farmer. Unfortunately very few board of county commissioners have backbone enough to throw out the lowest bidder, provided such bidder can make bond. The law generally says the contract shall be let, if at all, to the lowest responsible bidder. County commissioners reason that any man who can make bond is thereby responsible, otherwise he could not get a surety. The experience of the writer has been that almost any man can make bond, regardless of his financial or moral responsibility.

An illustration of this point: Bids were opened in an Alabama County for the construction of 6 miles of top-soil road. Two bids were by farmers who had never done any kind of road work. Both of them bid absurdly low. On plain and reinforced concrete, the lowest bids were $1.50 and $1.75 per cubic yard respectively. Both bidders were far below cost on other items. The court objected strenuously when the assistant state highway engineer refused to consider these bids, and argued that if the low man could make bond, the contract should be awarded to him. Although the third man's bid was very reasonable and he was a responsible, experienced contractor, it was thrown out because of the two worthless bids below his, and new bids were called for. The sequel—one of the two men who were low the first time, again was low, at better but still low prices. He was awarded the contract, and much to the surprise of everyone made bond with a reputable bond company. Needless to add, the engineer had his hands full in seeing that the specifications were complied with.

It is difficult to convince the average county board that a reputation for good and honest work is a great asset and should be taken into consideration. It would be difficult to value a good reputation in dollars and cents, but it is not difficult to measure the value of a contract with a reputable contractor in comparison with a contract made with a contractor without reputation.

The inclination of the public to criticise a board for not awarding a contract to the lowest bidder is, of course, the chief cause of this trouble. The public knows nothing of the relative value of bids and draws no distinction between contractors. A bond and the engineer are the twin reasons offered as an excuse for awarding a contract to an incompetent man or firm. No contractor who is well equipped and bears a reputation for doing honest and efficient work should be barred from bidding on work, but on the other hand it is far better to place the stamp of disapproval on a man before his bid is offered than to take a chance on his not being the low bidder.

RELIANCE ON CONTRACTOR

In the construction of sand-clay and top-soil roads a contractor experienced in such work is of great value to the engineer. By the proper handling and distribution of earth in grading, material that is genuine sand-clay or top-soil can be left on the surface for a final wearing surface. An engineer cannot be constantly present to direct such work and of necessity must depend to a certain extent on the good judgment of the contractor.

A large percentage of stations on a sand-clay road are generally finished when grading is finished, for the reason that the hills usually contain sand-clay naturally mixed, so that when graded down the road in the cuts and for some distance out on the fills both ways are of the proper mixture. This necessitates care upon the part of the contractor to the end that the finished grade has the proper cross-section and a uniform smooth surface. It frequently happens that after passing over a sand-clay hill the road for a mile or more is through deep sand or a sticky clay not suitable for road building. The cutting of this hill below the soil line is left until the sand part is ready for surfacing. The material from the cut being used for surfacing, the contractor is paid for the work at his surfacing price.

In this work the importance of the contractor's having a good knowledge of the road-building qualities of sand clay and top soil and of being able to tell good from bad on sight cannot be overestimated. He can make money for himself and save a great deal for the county. He soon becomes convinced of the importance of machining his road daily after exercising great care in the spreading of material.

When mixing sand with clay is required, the good judgment of the foreman in charge is worth a great deal. Nothing is better to compare it with than the skill of mixing flour to make bread. A novice might follow the recipe to the letter and make a failure where the cook with good judgment and skill never fails. As a little too much flour will spoil the bread, a little too much sand will spoil the road. No specifications, it matters not how carefully written, can cover the constant change of soils, except in a general way, and the co-operation of the contractor is therefore very valuable. We in Alabama who have charge of road work endeavor to make the contractor feel that the road is his and that he should take a pride in it. To this end, he is given full credit for his good work by appreciative comment, and by praise through the local paper when opportunity presents itself. Nothing discourages a man more than to have someone else receive the credit to which he himself is entitled.

EQUIPMENT

The most successful contractors confining their work almost exclusively to sand clay and top soil roads have been those who have been equipped with good teams and up-to-date machinery, and who have so systematized their work that when a monthly estimate is received they can tell at a glance what unit of the work was done at a loss and where a profit was made. A number of small contractors a few years ago, bidding only on jobs with total expenditures of from $5,000 to $15,000, by close attention to work have succeeded to the extent that they do not hesitate to bid in work involving an expenditure of $100,000 or more. Without a doubt the most successful contractors are those who give careful consideration to their outfit. The man who starves his live stock, neglects his machinery and cheats his labor is doomed to failure.

Influence of Federal-Aid Road Law on Highway Development

Measure Gives First Importance to Maintenance, Will Set Better Road Standards in All States and Bring About Uniform Accounting System

By A. B. FLETCHER
Highway Engineer, State of California

AT LAST, after many years of argument, the United States Government has entered into active participation in the improvement of highways. The writer for nearly 25 years has listened sceptically to the prophecies made at each session of Congress that a national road bill would be forthcoming.

The restrictions under which the funds are to be expended insure to the people of the country indirect returns of very great value, in addition, of course, to a large additional mileage of improved road, made possible by the funds appropriated by the act. These indirect returns are found in the influence which the measure will have on all the highway work of the nation, even on that which does not get federal aid. It will put maintenance in a new light, particularly before laymen highway officials. It will set higher road standards for every section of the country. It will bring about a uniform system of road accounting.

Before discussing these influences of federal aid it will be well to review briefly the outstanding features of the present law.

In the strictest usage of the term, the national road has not arrived yet, but the Bankhead Bill signed by President Wilson last July is a near approach to such legislation. This law, known as the Federal Aid Road Act, is a compromise measure, but, unlike most compromises, it seems likely to be most effective and to answer most of the requirements.

Two factions have for years been importuning Congress to appropriate government money for road purposes. One party, representing perhaps chiefly the agricultural interests of the Middle West and the South, has desired an appropriation to be assigned in relatively small allotments to all of the counties of the United States, the money to be used by these counties substantially at their discretion and with little or no control by the Federal Government. This plan of course smelled loudly of the "pork barrel," but it had many advocates. Another party, with which the motor-vehicle enthusiasts allied themselves, urged a policy almost diametrically opposed. They desired a system of national roads built and maintained by the government, as are the *Routes Nationales* of France, and to extend from the Atlantic Ocean to the Pacific and from Canada to Mexico.

Neither scheme prevailed, but the law which passed approaches more nearly the national road idea and indeed, in the future, a national highway system may develop from the Federal Aid Road Act.

MAIN FEATURES

Secretary Houston of the Department of Agriculture, in his article in the *American Review of Reviews* last September, explained some of the features of the new law in the following language:

"It authorizes the Secretary of Agriculture to co-operate with the states through their respective state highway departments in the construction of rural post roads. This principle is important and significant. Heretofore the agencies of the state and the federal governments have too often usually proceeded entirely independently and not infrequently worked at cross purposes and sometimes in an antagonistic spirit. The principle of co-operation between the two governments is extending and promises much for the people whom they serve.

"Federal money may be expended only for the construction of post roads. The term 'construction' is interpreted to include reconstruction and improvement, the latter excluding merely the making of needed repairs and the preservation of a reasonably smooth surface. To maintain the roads constructed under the provisions of the act is made the duty of the states or of their civil subdivisions according to the laws of the several states, and it is provided that, if the Secretary of Agriculture shall find any road in any state so constructed is not being properly maintained within a given period, he shall give notice of this fact to the highway department and, if within four months from the receipt of the notice the road has not been put in the proper condition of maintenance, no further aid can be extended to such state or civil subdivision.

"Perhaps the weakest point in good roads legislation and practice has been the lack of adequate provision for maintenance. It will be essential under the terms of this act that, in considering proposed road projects, careful regard shall be given to the provisions to be made by the states or their civil subdivisions for the maintenance of roads in the discharge of this duty. The construction work in each state must be done in accordance with the laws of the state and under the direct supervision of the state highway department, but the Secretary of Agriculture is given power to inspect the work as it proceeds, to approve it, and to make the necessary rules and regulations for the enforcement of the act. It is stipulated that the projects shall be substantiated in character and that expenditure of federal funds shall be applied only to such projects.

"In accepting the terms of the act the state, as a matter of course, pledges its faith to the five-year program. This is important because it makes possible the arrangement of a comprehensive scheme of road building. Obviously the expenditure of the entire amount of money contemplated under the act should be planned at the outset as far as possible and road systems and projects conceived accordingly. This does not bind the state legislature to make an appropriation at the first session for the five-year period. This would be prevented by the constitution of many states; but it does involve a pledge of the state's faith to continue the appropriations according to the terms of the act; and even where the counties contribute the necessary funds, the assent of the state must be had and the other terms of the act, such as the existence of a highway commission and the acceptance of the duty of maintaining roads, must be complied with.

"The contribution of the Federal Government for the construction of any road is limited to 50 per cent of the estimated cost of it and cannot exceed 50 per cent of the actual cost.

DEALS WITH HIGHWAY DEPARTMENTS

"The state is the lowest unit with which the federal government may co-operate, and only through a state highway department. This is made especially clear by the requirement that the Secretary of Agriculture and the state highway department of each state shall agree upon the roads to be constructed therein and the character and method of construction, and that any state desiring to avail itself of the benefits of the act shall by its state highway department submit to the Secretary of Agriculture project statements setting forth proposed road construction. If the secretary approve such project the highway department shall furnish to him such surveys, plans, specifications, and estimates therefor as he may require.

"It will be especially noted that there must be an agreement between the Secretary of Agriculture and the state highway department of each state on the roads to be constructed, that projects, plans, specifications, and estimates shall be submitted by the state highway departments and approved by the Secretary of Agriculture before any federal money can be expended.

"The initiative under the act lies with the states, and the federal government cannot begin operations until after the acceptance of the act by the state, a state highway department has been created, if none exists, and road projects and the requisite engineering data have been submitted to the Secretary of Agriculture and approved.

"This Federal Aid Road Act was designed not only to promote road-building, but also adequately to safeguard through efficient machinery the expenditure of all funds arising under it. There is good reason for believing that these purposes will be realized. It is highly probable that it will do much more than this. As has been pointed out, the nation is now annually spending the equivalent of $225,000,000 for road-building. The improvements of administrative agencies and methods which will certainly follow the operation of this act should lead to greatly increased efficiency in the expenditure of these large additional sums. In such case, the nation will realize great benefit not only from the expenditure of the joint funds but also of the separate surplus money of the states and communities."

NO PORK BARREL

There is little chance of politics in the plan as Secretary Houston explains it and the writer is unable to see in the law any "pork barrel" possibilities.

By the secretary's insistency upon a five years' plan of operation, vouched for by state authorities as a condition precedent to his approval of any project for federal aid, it is assured that the government money will not be spent in haphazard fashion nor piecemeal on short roads not connected with a comprehensive highway system.

The act seems to emphasize somewhat unduly in the opinion of many state highway officials the post-road feature. A too rigid construction of the wording of the law would limit the use of the government appropriation to work on rural post roads and bar out some vastly more important trunk lines over which, from force of circumstance, the United States mails are not now carried, but it is believed that the Department of Agriculture will construe somewhat liberally the provision of the act that the term " rural post road" means "any public road over which the United States mails now are *or may hereafter be transported*" by placing considerable emphasis on the words "or may hereafter be." But little imagination is needed to foresee that the mails must shortly be carried over nearly every main road important enough to be considered by a state as a part of its state highway system.

The real work of administering the activities under the Federal Aid Road Act will fall upon the Office of Public Roads and Rural Engineering of the Department of Agriculture. This subdivision of the department under Logan Waller Page, its director, has been in existence for many years. Its activities heretofore have been limited chiefly to research work, the giving of advice to highway officials, the publication of bulletins concerning road economics and the construction of a relatively small mileage of experimental highways. All of these activities have been useful and necessary and ably administered, but hereafter the Office of Public Roads will be engaged mostly in a far more valuable character of work in so far as the betterment of the highways of the country is concerned.

Under the present law the office will be concerned with the expenditure of not less than $170,000,000, including the combined federal and state appropriations and the roads in the National Forests. This means that the office will examine and criticise the plans and specifications for probably more than 20,000 miles of rural highways, and it has an opportunity, such as has never before been possible, to exemplify and to enforce the best practice in highway engineering in all of the states of the Union. All of the highway work done with this huge sum will be under the inspection of the engineers of the government. No inferior work will be tolerated, and if such work is attempted the government payments will cease. With the government funds at its disposal the Office of Public Roads has the whip, but it is almost unthinkable that the whip will ever have to be used.

STANDARD TYPES OF ROADS

The writer does not believe much in the so-called standard types of road for use everywhere, believing that it is obvious that the particular needs of each locality should be studied, but the federal engineers will doubtless standardize the different types of pavement and their advice will be invaluable because of the great extent of their field of operation.

In the matter of new surveys and plans the government engineers will set up standards of excellence which the states will doubtless gladly conform to. These standards will be of great assistance in some of the states where the state highway departments are none too strong. Often the highway engineer has had difficulty in convincing the members of the legislature of his state that accurate surveys and plans are needed and he has had to work with insufficient appropriations for engineering expenses, but if he can point to the government requirements for these features, he will need no further evidence.

The government requirement that cost data be kept upon demand on the federal-aid projects will produce a mass of information of great value to the highway officials of the country. Final reports of each project on forms prescribed by the government showing the work done and its cost analyzed will be required. Comparisons may thus be made easily, not only of the cost of projects within the boundaries of a single state, but also between the costs of work in the different states. Such comparisons will be extremely useful.

In the single matter of "overhead" expenses, if they are reported on the standard forms prescribed by the Office of Public Roads, it will no longer be possible for a state to report its "overhead" on its state highway construction at 3 per cent and make anybody believe that it has included all of the items which should have been charged to that account.

PROPER MAINTENANCE THE CHIEF BENEFIT

But perhaps the chief benefit to accrue from the federal aid law lies in its provision for the proper maintenance of the highways after they are built. No project for federal aid will be approved by the Secretary of Agriculture until a showing is made that funds are available or will be made available for the maintenance of the work to be done under the project agreement. Further, as Secretary Houston has stated, the law provides that if the road is not put into proper condition within four months from the receipt of a notice from the secretary, no further road project from the state concerned will be approved.

Arch Design Adopted for Galveston Causeway Reconstruction

Reinforced-Concrete Arch Plan and Continuous-Girder Plan Compared—Reasons for Changes Recommended by Arbitration Board

AFTER the hurricane and storm of Aug. 16 and 17, 1915, washed out the 5900 ft. of paved sand-fill approaches of the Galveston causeway, leaving intact, however, in the middle of the bridge the twenty-eight 70-ft. main arch spans of reinforced concrete, plans were made for new approaches. After more than a year of delay and differences between the five interests concerned in the reconstruction, the arbitration board appointed to decide whether the early proposal for arch spans or a later alternate design of continuous curved reinforced-concrete girders should be adopted has reported in favor of the arch type, as noted in the news section of the issue of Dec. 16. This design, by the terms of the arbitration agreement, has been adopted by the board of engineers. The finding showed the arch design to be $141,000 less in estimated cost than the curved-girder design, allowing for the recommended changes.

An account of the storm damages, together with a drawing showing the details of the 70-ft. existing arch spans and the old approaches, will be found in the issue of Aug. 28, 1915, page 271. The present article will consider the details of the adopted 60-ft. arch spans, of the alternate 30-ft. girder spans, the recommended changes made by the Board of Arbitration and the reasons for them.

INTERESTS CONCERNED

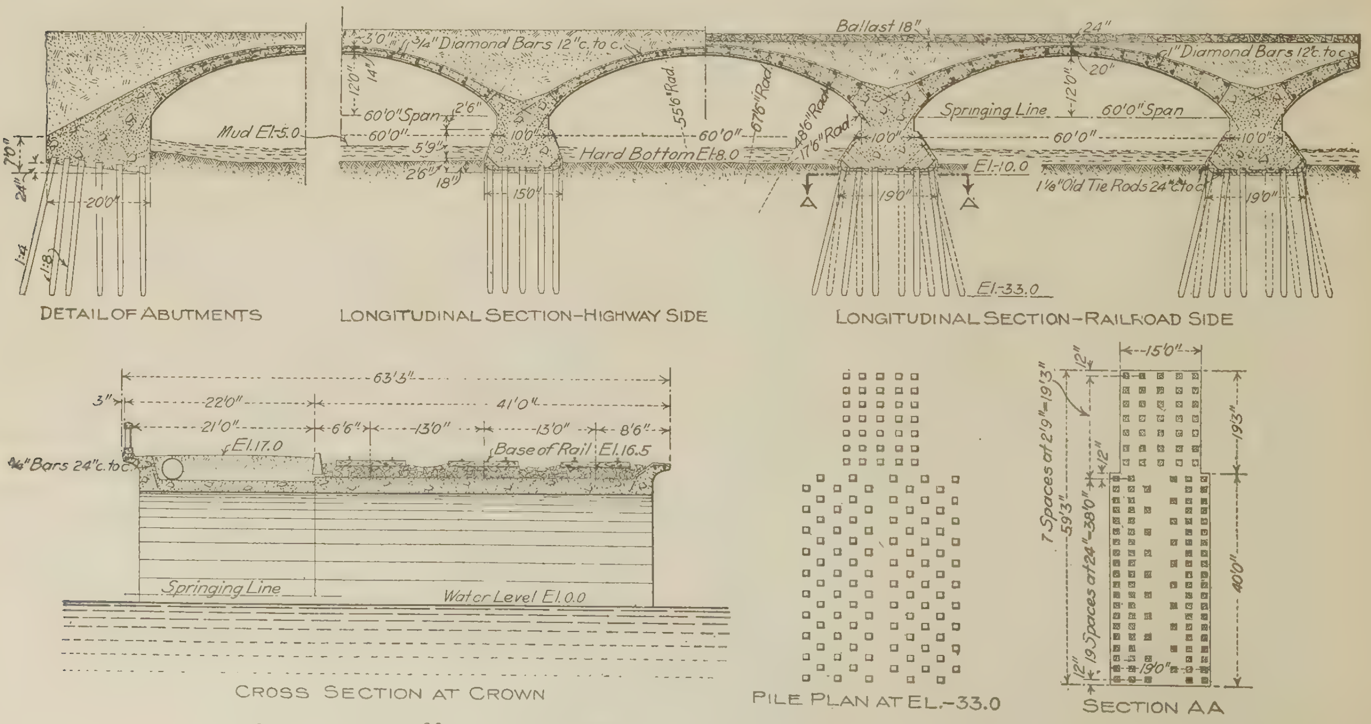
The Galveston causeway is to be used by five different interests, each interest having one representative on the Board of Engineers which was given authority to act upon the details of the reconstruction. The three railroad interests are the Gulf, Colorado & Santa Fé Railway, represented by F. Merritt, chief engineer, selected as chairman of the board; the Southern Pacific Railway (Sunset Central Lines), represented by I. A. Cottingham, engineer, and the Galveston, Houston & Henderson Railroad, represented by J. H. Hill, vice-president and general manager. Galveston County is represented on the board by the county engineer, R. M. Sias, and the Galveston-Houston Electric Railway Company is represented by Mark Lowd, Southwestern manager, Stone & Webster Engineering Corporation.

DESIGNS CONSIDERED

After consideration by this board of an arch design, there developed on the part of the railroad interests during negotiations seeking to fix the proportionate share of each interest in the cost of the reconstruction a desire to obtain alternate plans. Several such designs were therefore obtained. The reinforced-concrete curved-girder type submitted by J. L. Harrington, of Harrington, Howard & Ash, consulting engineers, Kansas City, Mo., was favored by the railroad interests, while the reinforced-concrete arch plan submitted by William Mueser, of the Concrete Steel Engineering Company, New York City, who designed the present 70-ft. arches, was favored by the county and the interurban railway.

A board of arbitration was then constituted to consist of one representative for the railroads, who selected Prof. A. N. Talbot of the University of Illinois, one for the other two interests, who selected Prof. George F. Swain of Harvard University and the Massachusetts Institute of Technology, and a third member selected by the other two to act as chairman—Lincoln Bush, consulting engineer, of New York City. After careful investigations and hearings in Galveston covering three days, the board on Dec. 4 unanimously recommended the arch plan. Through the courtesy of Mr. Merritt, chairman of the board of engineers, the alternate plans and recommended changes are here presented.

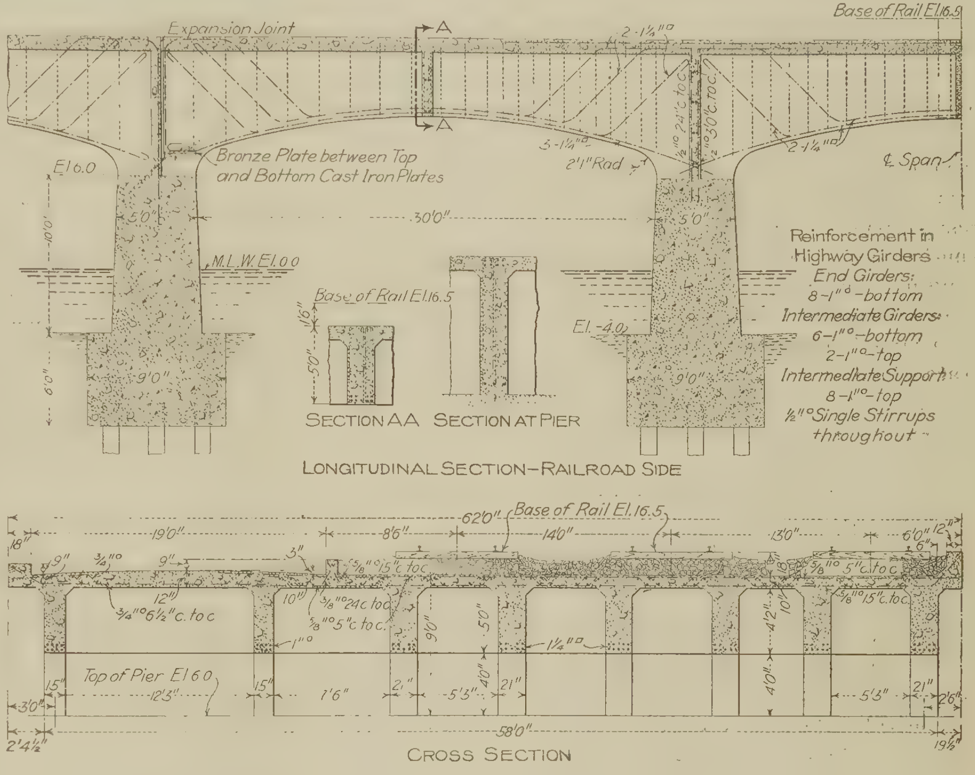
The arch design is very similar in outline to the existing 70-ft. arches; in fact, the first proposal was to use



DETAILS OF THE 60-FOOT ARCH DESIGN WHICH WAS RECOMMENDED BY THE BOARD

70-ft. arches on each side of the existing spans and 50-ft. spans between the uninjured sheet piling. When the desire for greater low-water areaway became apparent and the removal of the piling was proposed, a new design for 60-ft. arches, as shown in one of the drawings, was developed. This was economical because it lowers the springing line and therefore reduces the unbalanced thrust on piers, and because in the construction of these piers the relative cost is less in proportion to the cost of piers for the 70-ft. arches in deeper water. More piers and shorter arch spans thus became the proper solution for greater economy.

Another element of economy is in the use of the old 1⅛-in. tie rods (with turnbuckles) spaced on 9-ft. centers connecting the two rows of sheet piles driven for the original structure. These rods are specified for the reinforcement of the new piers, and it is proposd to clean and cut them to length by oxyacetylene flame. Thus the cost per ton for reinforcement is reduced from about $80 to $30. Reinforced-concrete piles 25 ft. long, 13 in. square at the top, 11 in. square at the lower end with 4-in. taper to a point 7 in. square are proposed for the foundations. The arbitration board, however, strongly recommends the consideration of creosoted timber piles. The present piers are founded on timber piles, but some question arose as to the danger from teredo, and the concrete pile design was made.



DETAILS OF THE ALTERNATE CURVED GIRDER DESIGN WHICH WAS CONSIDERED BY THE BOARD

After construction, the present concrete sheet piling is to be drawn or broken off at the bed of the bay, and thus a maximum of unobstructed waterway will be furnished. There will be fifty-two 60-ft. clear arch spans in the 3650 ft. of the approach on the Virginia Point side, and thirty-two spans in the 2250 ft. of the approach on the Galveston side.

30-FOOT REINFORCED-CONCRETE GIRDER DESIGN

As shown by the drawing of the details of the continuous girders, two sizes of curved girder, one for the highway part and one for the railway part, were designed. For the roadway portion of the structure a live load of 150 lb. per square foot in conjunction with either 12-ton motor trucks or a 15-ton road roller was assumed, with 25 per cent impact for the concentrated loadings. For the railroad girders Cooper's E-50 loading, with 40 per cent impact, was used, assuming each axle load distributed over 13 ft. transversely. As expansion joints occur at every third pier, the structure is continuous over three 35-ft. spans between centers of piers, or a length of 105 ft.

The piers were detailed as shown, 5 ft. wide at the top, tapering slightly to the spread base. Piles in three rows, fifteen in each row, are shown. At the piers where expansion joints are provided copper-plated cast-iron plates are shown, with a curved surface specified for the upper plate and a bronze bearing plate between.

RECOMMENDED CHANGES—ARCH PLAN

As a result of independent exhaustive analysis of the arch design, the board of arbitration made four specific recommendations: (1) The addition of ⅞-in. square longitudinal bars 14 ft. long on 12-in. centers between the reinforcement shown on the plan in the extrados at the ends of the arches under the railroad and interurban tracks, starting at the centers of piers; (2) the addition of ½-in. longitudinal square bars 14 ft. long on 12-in. centers between the bars in the intrados at the crown under the railroad and interurban tracks; (3) the widening of the concrete pier bases 2 ft. on each side only for 2½ ft. depth; (4) the use of a richer mix for the piers, abutments, spandrel walls, and end retaining walls, making this concrete 1:8 instead of 1:9 for ratio of cement to aggregates.

The reasons for these changes are as follows: (1) The computations for maximum stress at the ends of the arch showed a possible tension of 124 lb. per square inch in the concrete (equivalent to about 1860 lb. in the steel) when a temperature variation of ± 15 deg. was considered with live loading simultaneously on all tracks. To prevent any possibility of cracking the concrete under a greater temperature range, the additional steel was prescribed. (2) To provide for possible impact effects from live loading near the crown where the depth of fill is 6 in. out to a depth of fill of about 3 ft., additional steel was specified. (3) To allow somewhat better arrangement of piles and to provide a wider margin for inaccuracies in driving and at the same time facilitate construction by widening the pier bases to the lines of foundation sheeting, if used. (4) To better prevent possible action of sea water a richer and denser concrete was specified.

Recommended Changes—30-Foot Girder Plan

The changes recommended by the board of arbitration and upon which the final estimate of cost was based include a considerable addition to the number of piles, changing the transverse diaphragms from 8 in. to 12 in. thickness, lengthening the piers, and the addition of steel in the bottom of the girders in the end spans.

The reasons for these recommendations are generally clear by inspection of the drawing. The greater number of piles would be required to carry the loading; the piers are not reinforced and are too short, being flush with the outside girders, inducing shear in the concrete from loads on these girders; the thickness of diaphragms was considered insufficient for lateral stability and to resist thrust from storm-driven wreckage or vessels, the longitudinal steel in the end spans for resisting positive bending moment was considered insufficient.

The design of the arch ring by the Concrete Steel Engineering Company was made by assuming the concentrated loads of one engine of Cooper's E-50 loading to be distributed uniformly over 13 x 56 ft., giving 487 lb. per square foot for all three tracks, with 50 per cent impact at the crown varying uniformly to 0 per cent at 25 ft. from the crown on each side, or 2 per cent decrease per foot.

In the analysis by the chairman of the arbitration board the arch ring was divided into twenty equal divisions, and the stresses in the top and bottom of each due to a single load at the center of each division were computed. Maximum and minimum stresses could then be obtained by loading the proper sections, assuming the concentrated loads distributed transversely over 13-ft. width. A temperature variation of ± 15 deg., based upon government records for mean monthly averages from 1871 to 1915 inclusive, showing a variation of 30 deg., was taken. Each member of the arbitration board made independent determinations of the stresses.

Relative Cost of the Two Plans

The relative costs of the two alternate designs, as estimated by the board of arbitration, are $1,344,000 for the arch plan as submitted and $1,431,000 for the girder plan, not including the cost of repairs on the Galveston approach. The recommended changes were estimated at $32,300 total for the arch plan and $86,000 total for the girder plan, so that final relative costs would be $1,376,300 and $1,517,000, a showing of $141,000 in favor of the arch.

The total cost, including repairs to the 2300 ft. of the Galveston approach, should fall within the $1,500,000 agreed upon by the board of engineers, as reported by the arbitrators. This total cost is to be divided among the five interests as follows: Forty-five per cent to the three railroads, 33 per cent to Galveston County and 22 per cent to the interurban railway. The board of engineers on Dec. 12 passed a resolution authorizing Mr. Mueser to draw up complete detail plans and specifications in accordance with the recommendations of the arbitrators, to include alternate plans for creosoted pile foundations, these plans and specifications to be approved by the board of arbitration.

Water Hammer Cracks Shell of Four Inch Centrifugal Pump

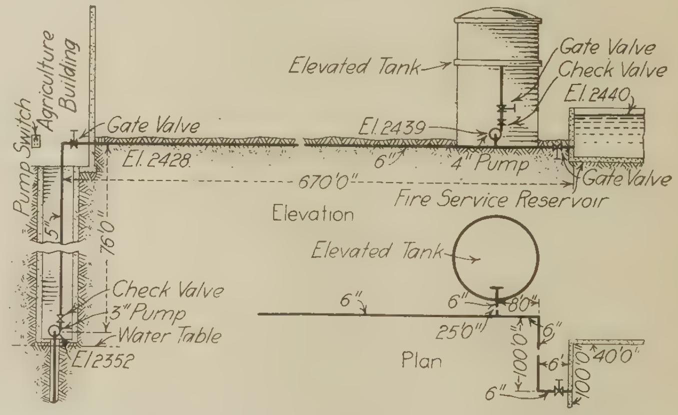
Flow to Fire-Service Reservoir Suddenly Stopped by Opening Switch on Power Line, Causing Impact of Water Columns in Pipe

By A. L. ENGER
Tucson, Arizona

Water hammer, resulting from a sudden shutting off of power from a well pump at the University of Arizona, broke the shell of another centrifugal pump employed as a booster to supply an elevated tank. To prevent the recurrence of such an accident a check valve has been placed in the pipe line near the fire-service reservoir into which the well pump discharged.

The sketch shows the system of piping from the well to the elevated tank and the new fire-service reservoir. The two pumps shown are single-stage centrifugal pumps direct-connected to induction motors.

The pump in the well has a 3-in. discharge and furnishes 415 gal. per minute when pumping into the fire-service reservoir. The pump under the tank is a 4-in. pump and is used for boosting the water from the 3-in. pump into the elevated tank. Ordinarily, the 3-in. centrifugal pump discharges into the fire-service reservoir, from which the water overflows into the irrigation system watering the campus.

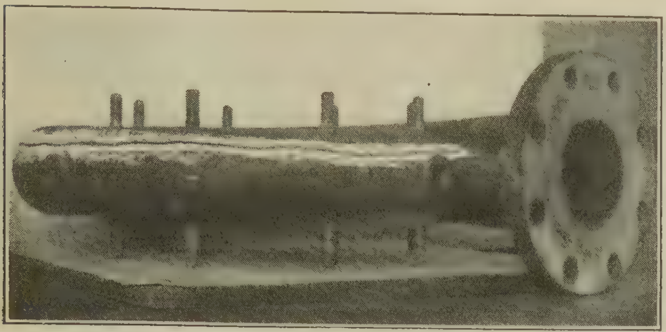


ARRANGEMENT OF PIPING, RESERVOIR AND PUMPS AT UNIVERSITY OF ARIZONA GROUNDS

Water Hammer When Pump Stopped

When the well pump was first installed, the violent water hammer caused by suddenly stopping the pump when discharging its normal capacity was observed, and a rule was therefore made that the gate valve in the discharge line at the top of the well should be closed—stopping the flow from the pump—before the pump was stopped. One day, through a misunderstanding, the main switch on the power line to the campus was pulled out while the well pump was discharging into the fire-service reservoir, and the resulting water hammer broke the case of the 4-in. pump under the elevated tank. The crack shown in the photograph is on the suction side of the case and extended about three-fourths of the way around the pump. The gate valve just over the 4-in. pump was closed at the time of the accident.

One explanation of this accident is as follows: It



HOW WATER HAMMER CRACKED CASING OF CENTRIFUGAL PUMP

is assumed that the water in the vertical section of the discharge pipe in the well stopped rising almost immediately after the power was shut off, and settled down on the check valve. The water in the horizontal pipe, flowing with a velocity of about 4.7 ft. per second at the instant the power was shut off, would not stop immediately, but would continue forward for a short time, due to its inertia, causing the column of water to separate near the top of the well. The pressure of the water in the reservoir then forced the water in the horizontal pipe back, and at the impact between the two columns of water a pressure wave was generated which traveled through the pipe line and broke the case of the 4-in. pump.

Blind Drains Cure Chronic Mudholes

Wet, soft spots in earth roads which easily become chronic mudholes are easily mended, says H. G. Shirley, chief highway engineer of Maryland, in *Illinois Highways*, by digging out the soft material and filling in layers of field stone. Three logs then make a blind drain and more stone and earth are placed on top.

No Rust in Galvanized Steel Tower at Iloilo After 12 Years

Unusually Severe Climatic Conditions Do Not Affect Coated Material—Economical Because No Maintenance Cost

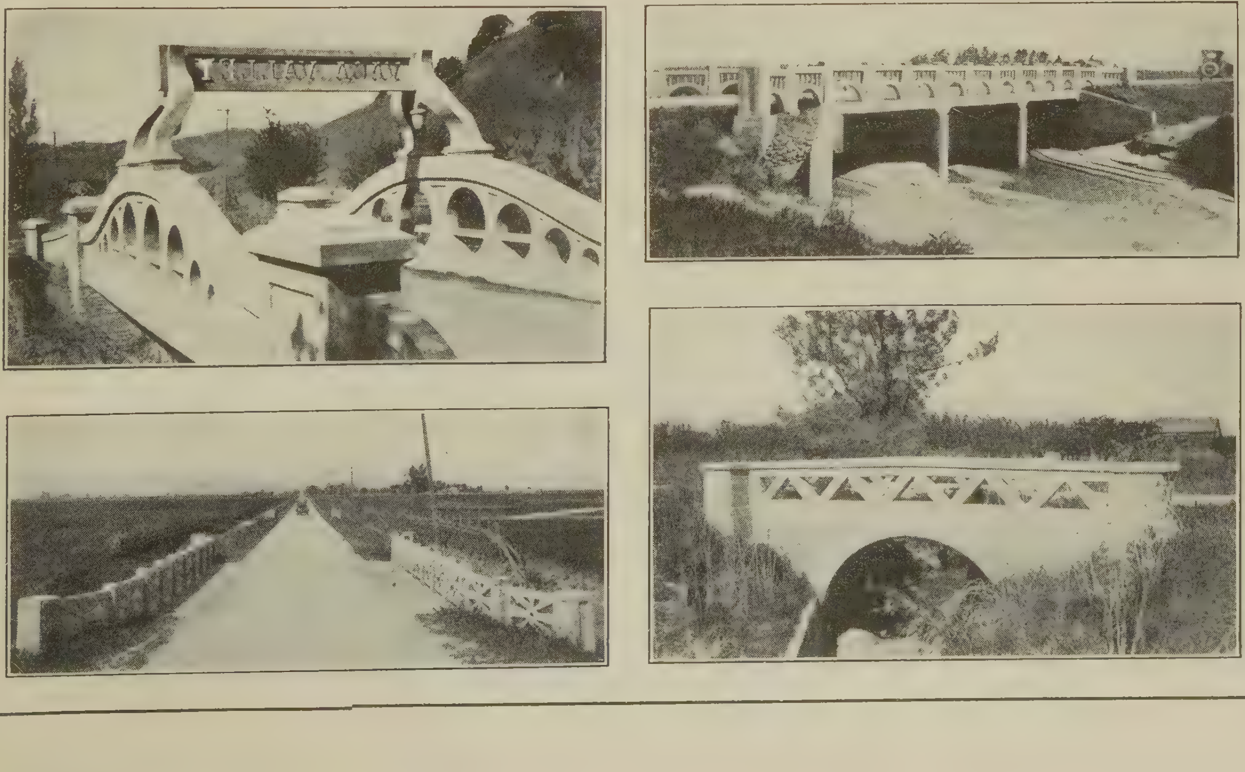
By J. L. HARRISON
District Engineer, Bureau of Public Works, Manila, P. I.

THE PRACTICE of protecting steel by covering it with coatings of various kinds of paint is so universal, especially as applied to framed structures, that any other method is conspicuous. Therefore the steel signal tower at Iloilo, in the Philippine Islands, a 100-ft. tower built for the purpose of making possible the observation of steamers approaching this port, is of unusual interest because it is an illustration of the success which may be obtained in preserving structural steel by galvanizing it.

In 1904 the customs authorities asked for bids on a signal tower which would be of sufficient strength to carry certain lights and signals and house the observer, whose duty it was to give notice of approaching vessels. They had decided that a wooden tower would cost less than a steel tower and would require much less maintenance because of the well-known fact that the sea breezes at Iloilo carry so much salt spray that steel structures have to be constantly painted and repainted; hence the average annual cost of a wooden tower would be considerably less than the average annual cost of a steel tower.

Believing this to be an illogical conclusion, a local firm of British engineers, Strachan & MacMurray, entered a bid on a steel tower and offered to design and erect a satisfactory tower for a price only slightly in advance

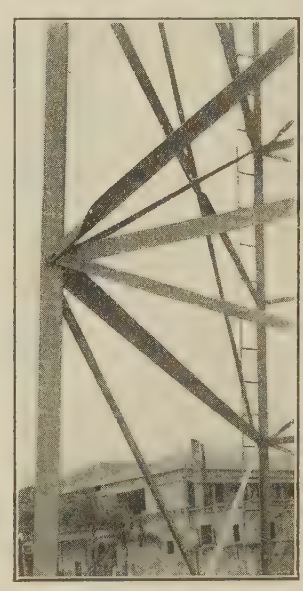
These Four Types of Rails for Concrete Highway Bridges Are Found in Solano County, California



of the price asked for a wooden tower. All members were to be galvanized after they had been cut and punched, and galvanized bolts, instead of rivets, were to be used throughout. After a careful consideration of the offer, the customs authorities accepted it and the tower was erected.

UNUSUAL CONDITIONS

The locality in which this tower was erected is unusual. Due to the salt breezes which prevail, and to the uniform high temperature, corrosion of iron or steel is very rapid. In fact, 1/8 in. of scale has been removed from reinforcing bars which had been left exposed near this tower for less than a year. Paint applied in three coats has to be renewed in from one to two years. Notwithstanding these severe conditions, this galvanized steel tower apparently has not a spot of rust on it. It has withstood the extraordinary deteriorating influences so well that the original shop marks on many of the members can still be read. In fact, to-day it is in practically the same state that it was at the time of its erection twelve years ago. Moreover, having served its usefulness in Iloilo, it is considered valuable enough to be taken down and re-erected at another port.


NOT A SPOT OF RUST AFTER 12 YEARS OF SERVICE

As far as can be learned, the maintenance cost on the tower has been absolutely nothing. It has never been painted, nor has any other work ever been done on it since erection. The query whether this method of preserving steel could not be more frequently adopted with economy naturally arises. Of course, just at present the price of spelter is abnormal, but under ordinary conditions there can be little doubt that the added cost of galvanizing steel would in many instances be much less than the cost of constant painting and repainting.

Probably the use of galvanized members would not often be economical in the northern part of the United States or in the arid regions of the West, but in the damper regions and in all coastal locations the capitalized cost of the constant maintenance which steel structures require would often considerably exceed the additional first cost of galvanizing all exposed members. In the tropics the cost of maintenance will almost always exceed the cost of galvanizing.

Will Publish Alaska Railroad Paper

The Alaskan Engineering Commission has established a weekly eight-page publication devoted to railroad construction work in Alaska for the dissemination of information of general interest to the thousands of employees of the various divisions of the government forces. The name of the new paper is the *Alaska Railroad Record.*

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Is Uniformity Possible in State Motor-Truck Legislation?

SIR: The editorial in the Engineering Record of Dec. 9, page 699, aptly sets forth the advantages of uniformity in state motor-truck legislation, and we feel that there is little of value that we can add.

Notwithstanding the desirability of uniform laws, there are some practical difficulties which may, to a certain extent, prevent the accomplishment of the desired end. For example, the Legislature of Michigan convenes Jan. 1, 1917. There is much sentiment in favor of passing laws which will limit the use of traction engines and motor trucks at the coming session. If the matter is not considered this year, the opportunity will be lost for two years, during which time much damage may be done.

Doubtless in other states also immediate action is necessary in order to present laws to the legislatures, thus precluding any general conference. Fortunately there is already some desire on the part of several states to correlate their legislation. Also there are almost certain to be minor modifications necessary in different states.

We should like to take this opportunity to qualify a statement made in our previous letter bearing on the subject of regulatory measures which appeared in the Engineering Record of Dec. 16. With reference to the use of steel tires on trailers we stated that their use would not be relatively more destructive to the pavement than similar tires on horse-drawn vehicles. This is, of course, true only when the truck and trailer are traveling at about the same rate of speed as horse-drawn traffic and with reasonable limitations as to loads.

FRANK F. ROGERS,
State Highway Commissioner of Michigan.
Lansing.

SIR: I believe you are right in the suggestion that the engineer, rather than the lawyer, ought to take up and solve the problem of the regulation of traffic to conserve highways. I have noticed with considerable interest your editorial of Oct. 28 on this subject, with comments in the issue of Dec. 16, and I am glad to find the engineering press placing the fact and experience of the engineers before the public so that our legislators may legislate with the fullest light possible.

At the September session of our Board of Supervisors one angle of this question was brought forward by the writer, and the board, by unanimous action, requested our local representatives in the General Assembly to take up the matter of the regulation of the use of tractors on our new public highways, particularly those tractor owners who persist in using lugs on the wheel rims.

Motor-truck traffic as at present developed in this community, ordinarily using rubber-tired rims, holds no terror for us when building rigid types of road. I feel that every style of vehicle ought to be regulated and limited to certain weights on wheel, width and length of vehicle, maximum load, etc., so that we may in the future be able to design a roadway satisfactory for the vehicle, for it is much easier to design the motor for the road than the road for the motor. The road of first-class type when constructed must necessarily last for a long time to give a return on the money expended. Motor trucks last a relatively short time, but succeeding manufacturers cannot be guided in the design when each manufacturer tries to outstrip his rival in the size and capacity of his motor; hence the necessity for state regulation.

It is the weakness of democracy, however, that no two states regulate exactly alike, and now that the motor truck has made the haul interstate, state legislation ought to be uniform, both for the use of the designers of trucks and of highways. I have no doubt that the Illinois General Assembly will legislate in some manner on this subject at the coming session of the legislature, and it is essential that the proper information be placed before the legislators so that the legislation may be wisely enacted.

P. C. McARDLE,
Vermilion County, Superintending Engineer.
Danville, Ill.

SIR: I read the editorial in the Engineering Record of Dec. 9, page 699, on uniform legislation throughout the different states for the control of motor-truck traffic on highways, with a great deal of interest. We have been giving this question considerable study, as we deem it one of the most important problems to deal with in road construction and maintenance. The development of motor-truck traffic has been rapid in the last few years, and, in my opinion, is just starting. Its possibilities are great. It is, therefore, an important problem and one which should be thoroughly studied before stringent rules or regulations are applied which will curtail its usefulness. I am heartily in sympathy with a co-operative movement among states to secure a uniform law, as near as possible, to meet local conditions which would govern the use of motor trucks on public highways.

The load per inch width of tire, speed, height of wheel and the width of motor vehicle should all be carefully gone into, and a standard reached, as nearly as possible. I do not see why it is not possible to specify the width of vehicle, the height of wheel, speed and load per inch width of tire, leaving the load that can be carried, including the weight of the motor vehicle, to be determined by seasonal conditions.

From a most careful study of the damage done by the use of such vehicles on certain types of roads, it has been my experience that the greatest damage is done in the spring of the year, when the frost is leaving the ground and the shoulders and sub-base are in the least stable condition to sustain the loads which are carried by trucks. We have found that during the summer months, when the sub-base is hard and the shoulders are firm and compact, the heavily loaded truck does not do a great deal of damage by breaking down the foundations or pushing out the edges of the macadam.

It is my opinion that to secure a maximum use of the truck and at the same time to do a minimum amount of damage to the road surfacing, laws should be enacted governing the load of the truck very materially in such a manner as properly to protect the roads at the critical seasons of the year. In other words, there should be a maximum load prescribed in those states where the climatic conditions are such that there is a great deal of freezing and thawing, and softening up of the sub-base during the months of February, March and April. In other sections, where the climatic conditions do not affect the sub-base to such an extent, the seasons could be specified accordingly. By this method I believe the road surfacing would be preserved and yet give to trucks the maximum carrying capacity which roads are capable of sustaining at all seasons of the year.

I believe that 650 lb. per inch width of tire is all that we can expect the roads heretofore constructed to withstand, and that it is very essential that the many millions of dollars which have heretofore been expended by the states and counties in constructing types of roads which were not designed to carry such traffic should be protected by putting certain restrictions on the loading capacity, speed and width of tires of motor vehicles.

H. G. SHIRLEY,
Chief Engineer, State Roads Commission of Maryland.
Baltimore.

SIR: I strongly believe that the adoption of standardized regulations governing the weight, size and speed of motor vehicles is a problem that at this time is in urgent need of solution by the joint efforts of highway officials throughout the country, with the co-operation of the manufacturers and users of motor vehicles. The alarming rate at which motor-vehicle traffic is increasing, both in weight, size and speed, especially on the through-route interurban highways, demands the immediate establishment of some definite and equitable relation between permissible traffic privileges and the economic limits of road widths and their construction and maintenance.

It is my opinion that such standard regulatory measures should indicate the maximum allowable weights per vehicle, per axle, and also per inch effective width of tire. As a safeguard against possible road damage through excessive speed, all motor vehicles, and also trailers, should of necessity be equipped with rubber tires. The advisability of prohibiting the use of certain types of solid-rubber blocked or cleated tires should also be considered.

The definition of maximum allowable speeds should be governed by the consideration of safety, general character of pavement, and the lines and grades of the highways. The indication of maximum widths for vehicles is a very necessary precaution, as in many instances the traffic capacity of highways is being considerably reduced through the operation of vehicles of excessive widths. Allowable maximum heights and lengths of vehicles and the permissible number and total length of trailers should also receive careful consideration.

Until all of these features have been fully discussed by all interests concerned, and definite standards determined upon, it is certain that more or less misunderstanding and friction will exist between the highway officials and the manufacturers and users of motor vehicles, to their mutual disadvantage.

W. H. CONNELL,
Philadelphia. Chief, Bureau of Highways.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

CONTRIBUTIONS *to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Adjacent Earth Dam Utilized to Save Concrete Tower

BY H. K. BELL

President, The Bell Construction Company, Lexington, Ky.

ADVANTAGE was recently taken by the writer of an earth dam to the top of which, 30 ft. above an adjoining filter plant under construction, concrete materials could be delivered, to lay out an economical concrete plant which did not require a hoisting tower. It is especially important in building filter plants to have as few operations as possible in placing the concrete, as a breakdown of any link in the chain may delay work long enough to cause horizontal joints. Where the plant under construction is located on a watercourse, it is often possible to take advantage of a bluff to avoid the necessity for a hoisting tower and at the same time secure the advantages of gravity distribution for the concrete. The dam utilized in this way in building the filter plant shown in the photograph, which is an addition to an existing water, light and ice plant, was 24 ft. wide on top. Concrete materials could be hauled to the top of this dam practically without extra cost.

A wheelbarrow run was built from the top of the dam to the mixer tower, erected close to the filter plant and built high enough to bring the mixer 26 ft. above the ground level. From this height all the concrete was spouted to place except that for a small part of the roof. A chute from the mixer led to a hopper suspended from a cable in a central position, from which any part of the forms could be reached by a second chute. The chutes and mixer could be gotten ready to concrete in about 15 minutes, which is a great advantage on this class of work. Often only half a dozen batches at a time are required, and it would be so expensive to rig up and operate the usual tower plant for such small sections that hand mixing would be necessary. Steam was supplied to the mixer on this work from the water plant.

The entire work was designed and carried out by the Bell Construction Company.

Brass Tack in Lead Wool Makes Easily Visible Instrument Point

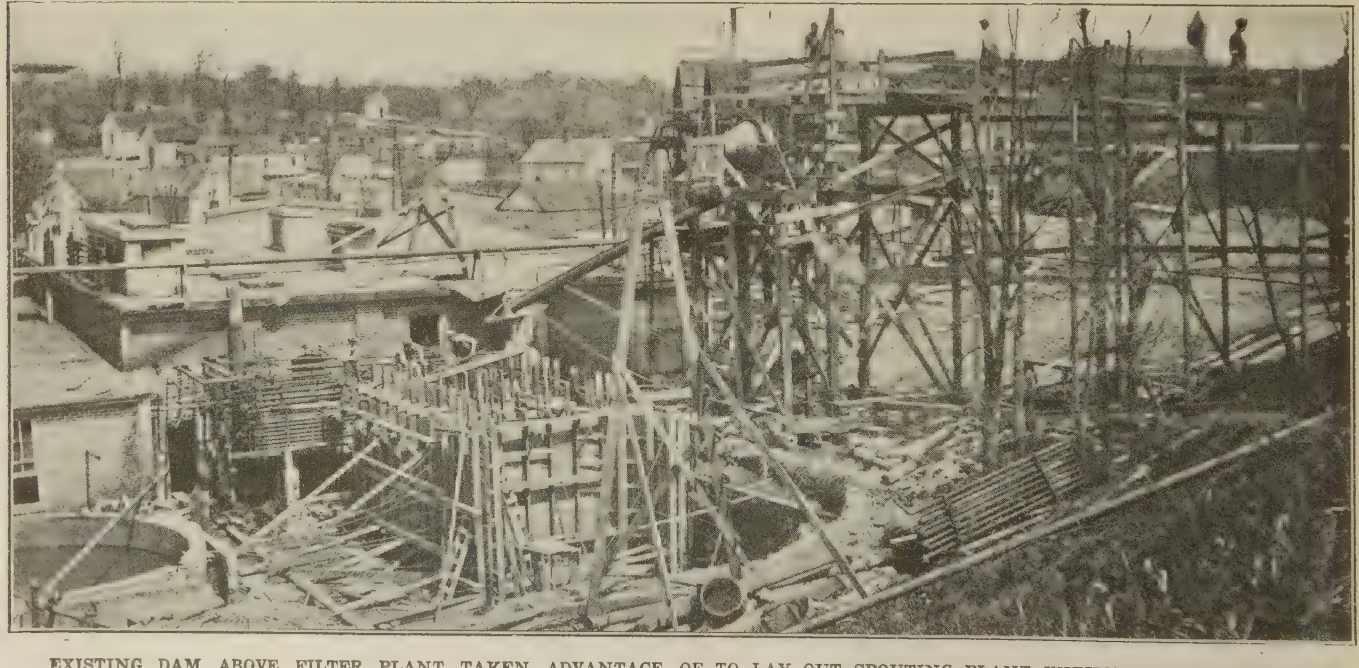
By S. L. TOLMAN

Springfield, Mass.

A BRASS TACK driven into lead wool tightly packed into a drilled hole makes a semi-permanent instrument point which is easily visible.

Contractors' engineers are often obliged to set points on finished concrete in giving lines and grades for construction work. Chalk and pencil marks are soon obliterated, chisel cuts are hard to find or easily chipped and rendered indistinct unless the concrete has thoroughly hardened, and in some cases cannot be used because they would constitute a permanent defacement. A brass tack, on the other hand, always stays bright even if set in a floor, and is easily seen.

The method which the writer has found convenient for setting such tacks is to drill, preferably when the concrete is one or two days old, a small hole an inch or more into the surface. This hole is then packed full of lead wool, into which a large brass tack with a small head is driven. Such points may, of course, be used either as transit points or as benchmarks in horizontal or vertical surfaces.

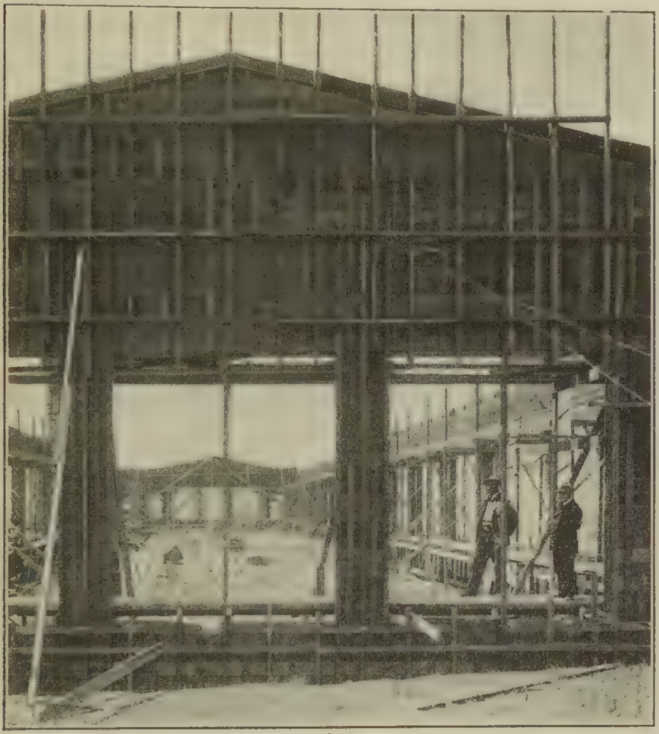


EXISTING DAM ABOVE FILTER PLANT TAKEN ADVANTAGE OF TO LAY OUT SPOUTING PLANT WITHOUT HOISTING TOWER

Built-Up Sections of Redwood Forms Used Repeatedly

REDWOOD forms for concrete which are built up in narrow sections are now being used over for the sixth time on building construction in the neighborhood of San Francisco. The idea developed last summer when an attempt was made to economize on form costs by putting up the forms carefully so the lumber could be used again. Redwood was selected because it was easy to handle and soft enough to permit of considerable nailing without splitting.

The first experiment was made on a structure with walls 22 ft. high and 280 ft. long. On commenting on the entire success of the experiment, the contractor on this job said: "After stripping we found no stains at all in the concrete walls. The dampness on one side and the exposure to sun and air on the other seemed to affect the lumber very little and caused no warping as in other lumber, thereby giving a smaller percentage of waste."



REDWOOD PANEL FORMS SUCCESSFUL IN CALIFORNIA

It was found that by building up sections of the forms 2 ft. wide and from 10 to 16 ft. long it was possible greatly to reduce the cost of handling, and the percentage of breakage was less, because when handled in sections less nailing was required. The sections consisted of four 6-in. tongue-and-groove boards surfaced one side and ⅞ in. thick. The boards in each section are held together with 1-in. cleats spaced 2 ft. apart. The sections are nailed to pine studding which is placed on 2-ft. centers instead of the usual 18-in., and the studs are in turn held by horizontal ties varying from 4 to 6 ft. apart.

Wires are run through the concrete in the usual manner to tie together the framing on opposite sides of the wall. Where the wall is interrupted by spaces for windows or other changes from a continuous surface, special short length sections are sometimes built, although it is customary to put these in without the use of cleats, as shown in the accompanying illustration.

The cost of this tongue-and-groove lumber in San Francisco is about $13 per 1000 ft. b.m., $2 per 1000 more than the lumber ordinarily used for formwork. It has been estimated that the saving by the use of the built-up sections amounts to about 25 per cent of the cost of the forms. This estimate is based on the saving of labor in erecting the forms and the saving in breakage, which is very much less than with the usual method. Credit for the development of this idea belongs to Christensen Brothers, general contractors, of Oakland, Cal.

Movable Flume Saves Time on Hydraulic Fill Dam

DURING the construction of a large hydraulic fill dam recently completed in the West, considerable time was saved by the use of an inclined runway for the flume from which material was deposited on the dam. Although the flume was moved by hand, it was only necessary to interrupt the flow for short periods while the delivery flume was skidded along the incline to the desired new position.

Three borrow pits were used, from which, by means of hydraulic giants, material was sluiced into three main flume lines. From these mains the material was conveyed through flumes along the upstream and downstream sides of the fill. By the use of gates the streams were discharged from the flumes at the desired intervals toward the axis of the dam.

DISCHARGE FLUME EASILY MOVED ON INCLINED SKIDS

A section of the distributing flume, shown in the accompanying photograph, indicates the inclined support. The flume box, 12 x 24 in. in section, was built up of 1¼-in. boards and was paved with 6 x 12 x 6-in. hemlock blocks set on end. Immediately above the blocks 1 x 6-in. projecting strips were nailed on either side. This box was supported on 2 x 6-in. stringers, which in turn were carried by 4 x 6-in. caps on the low sliding bents spaced 15 ft. apart and inclined on a slope of 5 to 1. The 6 x 6-in. inclined caps were supported on pieces of the same size resting on the material previously deposited and tied together by cross-bracing.

The flume proper was moved up the incline by means of a lever and chain device at each bent. The lever consisted of an iron bar near the lower end of which was fastened a chain connecting with the framing of the flume box. At the extreme lower end of the bar a second chain was attached which passed over an iron claw fastened to the upper end of the inclined 6 x 6-in. cap. This lever was operated by one man at each bent. With the lever in an upright position, pulling it down through the quadrant, which it was possible to describe, would move the flume up the incline a few inches. This gain was then caught by taking up slack in the chain at the claw, and the operation repeated.

Short lengths of lateral flumes were attached to the openings in the upstream side of the flume box to facilitate control of the flow. Doors for closing the openings were provided so that material could be discharged at any desired point along the crest of the fill, a duplicate line of flume being used along up and down stream faces. Of course each time the flume was moved it was necessary to establish a new connection at the point where it was fed from the supply flume. Sluicing was carried on practically continuously night and day in order to save time, and the movable feature of the flume was considered to be a factor in the progress made on the job.

Harrisburg Bridge Centers Moved in Average Time of Six Hours

By FRANK P. KEMON
Atlantic City, N. J.

THANKS to well-arranged trucks and rigging, it was possible to move and replace in an average time for the entire work of 6 hours per change the large half-arch centers used in constructing the concrete bridge recently completed for the Cumberland Valley Railroad at Harrisburg, Pa. The bridge, which spans the Susquehanna River and measures four-fifths of a mile in length, was described on page 340 of the Engineering Record of Sept. 16 last.

As will be remembered from this article, the half-arch forms for this work consisted of lagging supported on curved strips and blocking carried by four 3-hinged steel arches which were tied across the bottom for moving with turnbuckle rods. As there were 45 arches, a total of 90 moves with these forms were required.

The trusses of the steel arch forms were bolted to 12 x 12-in. yellow pine stringers across each end, which supported them during moving and also while resting on other timbers carried by the brackets built into the side of each pier to support the centers during concreting. The moving weight of each of the 10 half-arch centers moved was about 18 tons. It will also be recalled from the article mentioned that the forms were handled from place to place by rolling them sidewise onto travelers on the construction trestle parallel to the bridge, pulling them along the trestle and rolling them back under the line of the bridge from the traveler at the new location. The elevation of the trestle was made such that the tops of these travelers were slightly below the seats on which the forms rested when in use.

In making the sidewise moves, the forms traveled on 2-in. pipe rollers which had been filled with cement grout to prevent their flattening. The pulling was done with two sets of falls at each end of the form, one set at each end to the near and one to the far side, which led to a locomotive crane on the trestle. The trucks on which the forms were moved along the trestle were made on the job from the wheels and axles of several 3-ft. gage dump cars. Each of them consisted of four 4-wheeled trucks, one under each corner of the form, running on the outside tracks of the trestle. Headroom was saved by making up each of these trucks in an ingenious manner. Short lengths of 60-lb. steel rail, one on each side of each truck, were clamped underneath the journals by U-bolts. On top of the rails rested 12 x 12-in. timbers connecting the pair of trucks at each end of the form. The rollers on which the forms were moved sidewise bore directly on these timbers.

TRUCKS BUILT TO TAKE UP LITTLE VERTICAL SPACE

The crew usually employed to move these forms consisted of a rigger foreman, six riggers, an engineer and a fireman. Counting that the centers supported about 275 yd. of concrete at each location, the cost of moving and placing them amounted to about 6½ cents a yard. The bridge was constructed by the Robert Grace Contracting Company, for which the writer was superintendent under B. R. Hundley, eastern manager.

Rebuilt Concrete Mixer Cleans Ballast

An old rotary concrete mixer has been put to clean old ballast by the Kansas City Railways. The device is described in the *Electric Railway Journal*. The old mixer has been removed and a conical screen substituted. This screen is about 6 ft. long and tapers from 18 in. in diameter in the motor end to about 3 ft. at the discharge end. The same gasoline engine which formerly drove the mixer now serves as motive power for the screen. The ballast, salvage from track under reconstruction, or other material to be screened, is thrown into a wooden hopper built in at the small end of the screen, and as the screen turns is carried by gravity toward the discharge end. In passing over the meshes of the screen, the dirt is loosened from the rock and sifted through to the ground below, where it is taken up by workmen and carried away. The whole machine is mounted on a portable truck, making it possible to transport it easily from one job to another.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

$4,250,000 Flood-Prevention Plan Presented

Los Angeles County, Cal., to Vote Soon on Project—Dikes to Cost About $1,285,000

Damage from floods in Los Angeles County, California, can best be prevented, according to J. W. Reagan, county flood-control engineer, by diverting silt-carrying streams from the harbors, by constructing large storage dams and smaller retarding dams in mountainous areas, by straightening channels, by protecting banks and training the flow of larger streams, and by controlling and spreading smaller streams. Construction work costing approximately $4,250,000 is recommended as imperative in his report to the board of supervisors. The board deems it advisable to include some additional territory in the district in need of protection. Mr. Reagan has been directed to prepare supplementary recommendations. When this has been done a bond election will be held.

Dikes Cost $1,285,000

The suggested scheme includes a dike between Dominguez and Cerritos hills, north of Long Beach, to divert the Los Angeles and Rio Hondo Rivers into Alamitos Bay at a cost of $1,285,000. Bank protection and the training of the Los Angeles, San Gabriel and Rio Hondo rivers would necessitate an expenditure of $825,000.

Boulder levees or piling, brush and rock protective works along smaller streams emptying into rivers in agricultural districts, check dams in headwaters of mountain streams, and spreading grounds at the mouths of cañons would cost $865,000, according to the report. A dam of concrete, or cyclopean masonry in Pacoima Cañon, about 5 miles northeast of San Fernando, is recommended. The structure will be 145 ft. high, 106 ft. thick, and 478 ft. long. Its upstream face will be arched on 400-ft. radius. The dam will form a reservoir having a capacity of 3200 acre-feet. Its cost is estimated at $359,463.

Several Dams Suggested

Another dam across Arroyo Seco, near Devil's Gate bridge, about 10 miles northwest of Pasadena, is suggested. This barrier, according to the report, would be 130 ft. high, 98 ft. thick, 310 ft. long and the upstream face would be arched on a radius of 400 ft., with a 120-ft. spillway and a 20-ft. roadway on top. The reservoir capacity is estimated at 6557 acre-feet and the cost of construction work, $290,000.

In San Dimas Cañon, near San Dimas, a dam 125 ft. high, 106 ft. thick, 265 ft. long on its upstream face, and with a capacity of 2500 acre-feet is thought necessary. Its cost would be $278,000. An earth dam is recommended north of Pomona to be 40 ft. high, 16 ft. wide at the top, and 200 ft. thick at the base. The reservoir capacity would be 2250 acre-feet and the cost of construction work $189,945.

May Vote $15,000,000 Bond Issue for Washington Irrigation

Olaf Laurgaard, consulting engineer, of Portland, Ore., who has been making exhaustive investigations during the last year of the Horse Heaven irrigation project in Benton County, near Prosser, Wash., states that the proposition is entirely feasible. In his recent report he stated that 210,000 acres could be watered by gravity flow at a cost of $45 an acre; the completed cost per acre, including storage, would be approximately $81. The report gives complete data, including precipitation, natural flow of the watershed, storage facilities and engineering problems to be dealt with.

Stating that 20 in. an acre could be put on the 300,000 acres included in the district, Mr. Laurgaard advised that 210,000 acres he put under gravity flow first and that the project be completed when the land under cultivation justifies the expense. Estimates on two sizes for the main canal were submitted. One, carrying 1250 sec.-ft. of water, will cost $9,476,000; another, carrying 1500 sec.-ft., can be built at a cost of $10,445,000. The canal will be 120 miles long. The cost for storage reservoirs will be $8,883,300. The total cost of the project will be $24,553,000. Mr. Laurgaard's recommendation that a bond issue of $15,000,000 be voted by the district has been taken under consideration by the board of directors.

Prices

of construction materials and an analysis of the railroad situation, indicating the possibilities of increased construction, will be found in the Contracting News section this week.

On pages 4 to 27 inclusive are the feature articles announced last week. Contractors will be interested in those on pages 7, 9, 11, 21 and 24.

California Commission Will Evaluate Water Property

500 Attend Spring Valley Company Hearing in San Francisco—Metering Thought Necessary

The opening session of the hearing before the California Railroad Commission in San Francisco, to determine whether the Spring Valley Water Company shall charge for its service in that city on a metered basis, was held on Dec. 27. So great was the interest in the case that only a small part of those desiring to hear the evidence could be accommodated in the commission's court rooms, and accordingly the hearing was adjourned to the municipal auditorium. The attendance there was about 500.

S. P. Eastman, vice-president and general manager of the company, testified that 65 per cent of consumers would save money by paying meter rates rather than flat rates. Max Thelen, president of the commission, stated the opinion of that body was that the service must be metered. The present minimum residence rate of $1.80 per month is too high, he thought, and a new rate schedule would have to be determined by the commission. In order that this be done with fairness to all parties concerned, the commission decided that an exhaustive investigation of the company properties by commission engineers was desirable, but preferred that request for such investigation come from the company. In response to this the attorney for the company promptly agreed to file a formal application for such valuation. This valuation proceeding will be of importance to the city because the commission's findings will be very useful in negotiating for the purchase of the system.

Water Famine Probable in 1920

G. A. Elliott, chief engineer for the Spring Valley Company, stated that the present developed supply was being taxed to the utmost to provide sufficient water for the city. During 1915 the daily average was 42.6 million gallons. The maximum rate of supply which could be maintained at present, he said, was 44 million gallons per day, and consumption in excess of this has to be drawn from reserve reservoirs. The capacity of these reservoirs was only sufficient to supply the overdraft for a few years, and at the present rate of increase in consumption this reserve supply would be exhausted by 1920 or 1922 and San Francisco would face a water famine.

It is expected that the statistics, when prepared, will show a decreased consumption for 1916 because of the close of the exposition, but the total during the first four months of 1916 was 4912 million gallons, as compared with 4798 million gallons during the same period of 1915. Relief from the present situation could be provided for, said Mr. Elliott, only by two methods—by building a new pipe line from Calaveras reservoir at a cost of approximately $9,000,000 or reducing wastage in San Francisco. The installation of meters he estimated would decrease the water consumption from 5,000,000 to 7,000,000 gal. daily.

Exonerated for Damages Caused by Reservoir Failure

Holding that the Sweetwater Water Company's dam near San Diego, Cal., was constructed by competent engineers, and that the flood of last January which carried away a dike that formed a part of the reservoir was an act of God, a decision recently rendered in a San Diego court exonerates the company for damages to property below the dam. The suit was for $13,000. Similar suits have been filed against the company for amounts aggregating $200,000 and also against the city of San Diego for damages caused by the washing out of the city's Lower Otay dam. In this trial evidence was introduced that the rainfall on Jan. 27 was three times greater than ever before recorded for one day in San Diego.

Purdue Holds Road School

The annual road school at Purdue University will be held Jan. 16 to 18. The main topic will be road conditions in Indiana. Lectures by state highway officials will be illustrated with pictures of roads in Indiana. The annual organization meeting of the State Association of County Highway Superintendents will be held Wednesday evening, Jan. 17. The meeting of the Indiana Engineering Society also occurs at Purdue University Jan. 18 to 20.

Concrete Convention in Kansas City

The convention and show of the Southwestern Concrete Association will be held Feb. 19 to 24 in Kansas City. The program includes papers on concrete in all its various uses, as well as dissertations on tests of sand, cement and the uses of hydrated lime. Prof. Duff A. Abrams of Lewis Institute will speak on sand and concrete tests; Lieut.-Col. J. F. McIndoe, Corps of Engineers, U. S. A., will tell of the uses of concrete on government work along the Missouri River.

Flat-slab design is the subject of the paper by Arthur R. Lord of Chicago, while Prof. A. N. Talbot of the University of Illinois will discuss concrete columns. Fireproof construction will be detailed by Ernest McCullough, while A. N. Johnson has agreed to talk on concrete road design. The maintenance of concrete roads will be explained by George A. Ricker of the Portland Cement Association.

American Society Meeting in United Societies Building

For the first time the business sessions of the annual meeting of the American Society of Civil Engineers will be held in the United Engineering Societies Building, New York City, beginning Wednesday, Jan. 17. It is expected that plans of the proposed addition and a model of the completed building will be available for inspection. Excursions to view subway work and Hell Gate bridge are planned for the afternoon of the first day. The reception that evening at the house of the society, 220 West Fifty-seventh Street, will probably be the last in the old quarters, which have served for more than nineteen years.

The second day—Jan. 18—will be devoted to an all-day excursion on the Hudson and East rivers. R. A. C. Smith, commissioner of docks and ferries, has arranged for one of the municipal ferryboats to transport the visitors. In the evening, at the society house, J. Howard Whitehouse, member of Parliament, will discuss economic conditions in England due to the war, after which a smoker will be held.

Special Joint Committee to Make Final Report

The special committee on concrete and reinforced concrete will make its final report, which is printed in the *Proceedings* for December, 1916, page 1657. This committee, generally known as the "Joint Committee," here reports the results of four years' further investigation made since the progress report of 1912, presented at the annual meeting in January, 1913, and printed in the *Transactions*, Volume 77, page 385.

The most striking and valuable feature of the report is the new section on flat-slab design, to which more than eight pages are devoted. Definite design assumptions and formulas, based largely upon empirical treatment, are proposed. Various minor changes are made, but in general the design formulas, notation, etc., previously recommended are retained. Joseph R. Worcester is chairman of the committee, which consists of representatives from the American Society of Civil Engineers, the American Society for Testing Materials, the American Railway Engineering Association, the Portland Cement Association and the American Concrete Institute. Richard L. Humphrey is secretary.

Lord Cowdray Given Charge of Aeroplane Service

Lord Cowdray, head of S. Pearson & Son, Ltd., of London, succeeds Lord Curzon as chairman of the air board, in charge of construction and equipment of all British navy and army aeroplanes. Lord Cowdray, whose biography appeared in last week's issue of the Engineering Record, is known in England as "one of the greatest organizers in the country." His new office is his first official position.

Consider Bay Bridge Near San Francisco

Three Propositions Submitted to Association Ranging in Cost from $210,000 to $797,000

A committee of engineers, made up of M. M. O'Shaughnessy, city engineer of San Francisco, Prof. Charles B. Wing, Stanford University, and Harlan D. Miller, bridge engineer, of Oakland, recently submitted a report to the Downtown Association of San Francisco on the feasibility of a highway bridge across the bay at Dumbarton Point, about 25 miles south of that city. The engineers reported that such a structure would be an aid to the government in providing for the defense of San Francisco Bay; that it would be of general benefit by bringing the Lincoln Highway directly into San Francisco; that it would provide a direct line of communication between San Mateo and Alameda Counties (a requirement of the state highway bond act); and that it would also benefit San Francisco and San Mateo Counties in providing a direct line of communication between the interior counties and the peninsula.

The Propositions

Three propositions were offered: (1) An agreement with the Southern Pacific Company whereby the present railroad bridge would be utilized for motor traffic as well as railroad traffic—estimated cost, $210,000; annual cost, $18,500 plus rent to the railroad; daily expense, $80; (2) an aqueduct bridge, which is now being considered by San Francisco as a possible alternative to a pipe line around the southern end of the bay—cost, $480,400; annual cost, $29,436; daily expense, $80; (3) a bridge for highway traffic only—estimated cost, $797,200; annual cost, $47,860; daily expense, $130. The engineers recommended that a committee be appointed to make a detailed study of the project and report upon ways and means of establishing reliable estimates of costs and their proper distribution.

Will Spend $100,000,000 on Steel Plant Improvements

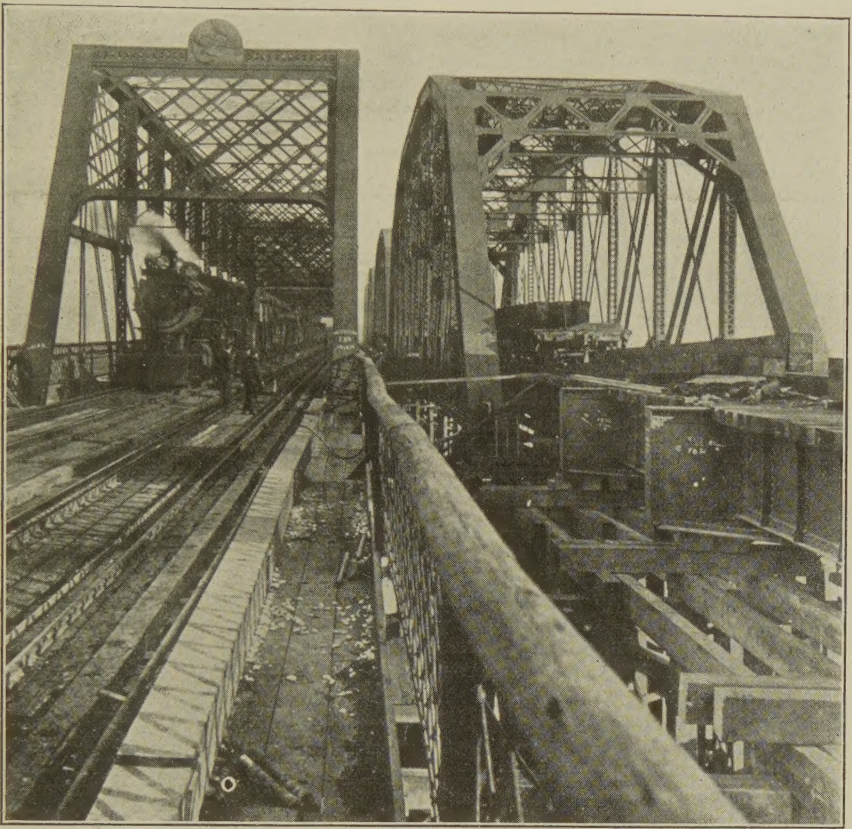
The Bethlehem Steel Corporation has under way a program for additions and extensions at the plants at Steelton, Bethlehem, Baltimore, Lebanon, Reading, Quincy, Mass., San Francisco and elsewhere, involving an expenditure of about $100,000,000 during the next two or three years. This expenditure will be made at the various steel plants of the company and at the coal and ore mines and shipyards controlled by the organization.

The Bethlehem Steel Company has acquired control of the American Iron & Steel Manufacturing Company plants at Lebanon and Reading and also the coke ovens and blast furnaces of the Lackawanna Iron & Steel Company at Lebanon, both owned and leased. No definite construction program has been developed for these two companies.

Big Increase Made in Tax on New York Motor Trucks

Ranging from a minimum of $10 for a commercial vehicle with a combined weight and carrying capacity of 2 tons, and increasing by increments of $5 per ton up to $70 for gross loads of 14 tons, with an additional charge of $10 a ton for weights in excess of 14 tons, the new schedule of fees for motor trucks in New York State, drafted by a special commission consisting of Frank M. Williams, state engineer, Gen. W. W. Wotherspoon, state superintendent of public works, and Edwin Duffey, state highway commissioner, was filed with the Secretary of State Dec. 29 and becomes effective Feb. 1. The new schedule, according to the terms of the legislative act creating the special commission, is required to be based upon "time and extent of use of highways" and "wear and tear" on roads. In the memorandum submitted to Secretary Hugo these matters are not mentioned nor is there anything said on the subjects of speed, tires, load per inch width of tire, overall dimensions or trailers. Compared with the old flat rate of $5 per vehicle the new tax represents a big increase in the annual sums which motor-truck owners will be called upon to pay.

The new schedule also levies higher tribute upon passenger-carrying omnibuses. Henceforth they will be called upon to pay a minimum fee of $15 for vehicles having a seating capacity of five persons or less. This tax is gradually increased to a maximum of $67.50 a year for every vehicle carrying not less than 27 nor more than 30 passengers. For every passenger in excess of 30 an additional $2 is required.



Change Bridge at Omaha with One-Hour Traffic Delay

A NEW RAILWAY BRIDGE 1722 ft. long, 70 ft. wide, weighing about 5000 tons and costing $1,000,000, was slipped onto the piers of the old one Dec. 22 at Omaha, Neb. The delay in traffic was less than an hour. The work was started at 11 a. m. and completed at 3.40 p. m., the same day. The new structure is designed to carry over the Missouri River the heavy traffic of the Union Pacific, the Chicago, Burlington & Quincy, the Wabash, the Chicago & North Western, the Chicago Great Western and the Chicago, Milwaukee & St. Paul railroads. It is owned by the Union Pacific. Work was started last May. The new structure was erected on false piers and slipped onto the masonry of the old bridge. The old structure, which is in good condition, was considered too light for the heavy traffic. The daily traffic amounts to about 320 trains.

Wants $6,000,000 to Spend on Pennsylvania Roads

In his annual message to the general assembly of Pennsylvania, submitted on the day the legislature convened—Tuesday, Jan. 2—Governor Martin G. Brumbaugh asked the law-making body of that commonwealth to give its attention to the questions of highway construction and the development of the state's water supply. The Governor asks that the state highway automobile license fund amounting to several million dollars each year, now part of a general appropriation of $3,000,000, be set aside for the special use of the highway department and that a straight appropriation of $6,000,000 be made for road improvement work. He also asks that appropriations be made for the taking over of toll roads; that state highways be developed as rapidly as possible; and that the law preventing the state from aiding boroughs in building good roads be changed.

Engineering Society Activities

Western Society of Engineers' annual meeting and dinner will be held on Jan. 10 at the Hotel Sherman, Chicago. James Keeley, editor of the Chicago *Herald*, recently returned from the war zone, will speak on his experiences. Dean F. E. Turneaure, University of Wisconsin, and Major-General Barry, recently assigned to the Central District, are also on the program.

Subdivision 63, Engineers, Chicago Association of Commerce, Dec. 20 elected the following officers for the coming year: I. F. Stern, chairman; Robert I. Randolph, vice-chairman; J. N. Hatch, Arthur Maldaner and W. W. De Berard, members of the executive committee. The recent petition for an increase in salary of engineering employees of the city of Chicago met with the approval of the subdivision. An attempt will be made to gain the support of the association. The same action was taken with reference to the report of the bridge safety commission.

San Francisco Association of Members of the American Society of Civil Engineers at the annual meeting last month elected the following officers: John D. Galloway, president; H. J. Brunnier, vice-president, and E. T. Thurston, secretary-treasurer. J. W. Swaren presented a well-illustrated lecture on "Undertones of Engineering," in which he outlined interesting features of construction work in Java, Sumatra, Philippine Islands and western America.

Southern California Association of Members of the American Society of Civil Engineers at a recent meeting in Los Angeles elected H. Hawgood, president, and Homer Hamlin, vice-president, for the ensuing year.

Florida Engineering Society was organized Dec. 22 and 23 at a meeting in Jacksonville, Fla. L. D. Smoot, commissioner of public works of Jacksonville, was elected president; W. P. Darwin of the same city and R. E. Chandler of Gainesville, vice-presidents; J. R. Benton of Gainesville, secretary, and H. D. Mendenhall, treasurer. It is the intention of the society to get the next Legislature to enact a law requiring engineers desiring to practise any one of the different branches of the profession in Florida to show necessary qualifications before being granted a permit.

What Engineers and Contractors Are Doing

C. K. Clark has been appointed chief engineer of the Imperial Irrigation District, succeeding Charles R. Rockwood. Mr. Clark assumed his new duties Jan. 1.

Thomas W. Hulme, general secretary of the Presidents' Conference Committee of the railroads, has been appointed vice-chairman of the committee.

H. C. Phillips, assistant general secretary of the Presidents' Conference Committee, has been appointed general secretary, succeeding Thomas W. Hulme. Before his appointment as assistant general secretary Mr. Phillips was valuation engineer of the Santa Fé system, and prior to that he was chief engineer of the Coast Lines of the Santa Fé.

Hernan Lois and Louis Matte, engineers in the employ of the Chilean government, are making a thorough study of American systems of irrigation and reclaiming arid lands. Considerable time was spent by the two men in the U. S. Reclamation offices, Washington, D. C. During the last few months they have carried on investigations in the irrigation districts of the West. At present they are visiting projects in Oregon which are completed or under way.

Harry F. Harris, first assistant city engineer of streets of Trenton, N. J., has been appointed county engineer to succeed Theodore Tobish. James Ross has been appointed supervisor of roads.

J. W. Kelsey, formerly chief assistant to the engineer of design and construction of the St. Paul water department, has been appointed principal assistant engineer of the department, to succeed Roscoe L. Smith. After graduation from Virginia Polytechnic Institute in 1909 Mr. Kelsey engaged in the coal and iron business in Alabama. The following year he entered the U. S. Reclamation Service. A year on the Sunnyside project in Washington preceded his appointment in 1911 as assistant engineer for the Canadian Pacific Railway. He went to the Northern Pacific Railway in 1913, with office in St. Paul. Since 1914 Mr. Kelsey has been in the employ of the St. Paul water department.

George B. Sturgeon, for the last ten years construction engineer at the University of California, has tendered his resignation, effective Jan. 1. Mr. Sturgeon will take charge of the construction of an irrigation system in recently opened tracts of farm land in southern California. While at the university Mr. Sturgeon acted as civil engineer of the architectural department and had charge of practically all construction work on the campus.

Charles H. Sweetser, district engineer of the U. S. Office of Public Roads, has opened headquarters in Berkeley, Cal., from which point he will direct road improvements in California, Nevada, Arizona and New Mexico. Under the federal road act the apportionment for the present fiscal year for the four states under Mr. Sweetser's supervision is $362,711.

L. D. Hollingsworth was recently appointed division engineer of the Kentucky highway department with office at Paducah.

George F. Blackie, formerly engineer of roadway and track for the Nashville, Chattanooga & St. Louis Railway, has been promoted to assistant chief engineer.

C. P. Ross has left the engineering department of the Union Pacific Railroad to enter the company's industrial department at Omaha.

L. D. Busby has resigned as chief sanitary inspector of the bureau of sanitation of Dallas, Tex. The office has been taken over by the superintendent of the street department.

H. H. Trabue, formerly assistant chief engineer of the Nashville, Chattanooga & St. Louis Railway, has been made real-estate agent. He reports directly to the president.

Joseph H. O'Brien, engineer for Westinghouse Church Kerr & Company, has been made vice-president of the General Construction Company, of Harrisburg, Pa. Mr. O'Brien has been associated with Westinghouse Church Kerr & Company for the last fourteen years.

Thomas H. Means, of Symmes & Means, consulting engineers, San Francisco, was recently appointed consulting engineer for the Anderson-Cottonwood Irrigation District at Redding. He succeeds H. H. Henderson, who resigned recently.

E. R. Gayler has been appointed, by President Wilson, an engineer adviser to direct public improvements in Hayti in accordance with the recent treaty between the United States and the West Indian republic. Mr. Gayler is a graduate of Washington University, class of 1895. In 1902 he entered the Navy Department. Since then he has been engaged on the development of new naval stations. He is responsible for much of the work of that nature at New Orleans, Charleston and Pearl Harbor, Hawaii. For the last two years Mr. Gayler has had his headquarters in Washington.

C. H. Hanson has been appointed superintendent of the Bucyrus Development Company water plant at Bucyrus, Ohio.

James C. Travilla of St. Louis has become associated with the Dunn Wire-Cut Lug Brick Company, of Conneaut, Ohio, in the capacity of consulting engineer. Mr. Travilla is a graduate of the civil engineering department of the University of Pennsylvania. During his professional career he has been in the engineering department of the Missouri Pacific Railway, assistant engineer in the water department of St. Louis and was for several years in charge of the estimating and drafting division of that city's street department. Later he was made superintendent of the street department and then street commissioner. Mr. Travilla resigned in 1913 as street commissioner of St. Louis and until 1916 had supervision and direction of the expenditure of $1,000,000 for good roads in Tarrant County, Texas. He also directed road work in other Texas counties. In March, 1916, he was appointed consulting and associate engineer for a $3,000,000 road system in St. Louis County, Missouri. This work was stopped by a ruling of the Supreme Court declaring certain road statutes invalid.

Wiliam M. Acheson resigned Jan. 1 as division engineer of Division 6, New York State Highway Commission, to become chief engineer of the Crescent Portland Cement Company at Wampum, Pa. Mr. Acheson received his engineering education at the Rensselaer Polytechnic Institute and Union University. He entered the employ of the Troy waterworks extension in 1900 as chainman and in 1902 had charge of the construction of the Quackenkill diverting dam. Two years later he went to the Isthmus of Panama as leveler. He was made acting resident engineer in the Bureau of Municipal Engineering in 1906 and in 1908, in the consolidation of departments and the reorganization, he was appointed engineer in charge of the third district of the Pacific division, which included the bureaus of municipal and sanitary engineering and building construction. In 1910 Mr. Acheson resigned to become supervising engineer of the County Construction Company. When the New York State Highway Commission was reorganized in 1913 he was appointed division engineer with headquarters at Buffalo.

R. S. Whiting, architect, of Grand Rapids, Mich., and formerly of Boston, has been added to the force of experts engaged in the trade extension department of the National Lumber Manufacturers' Association, with headquarters in Chicago. Mr. Whiting's work for the lumber men will be to study building codes, and assist architects who are trying to develop a model code for wood construction.

R. K. Rochester has been promoted from superintendent of the Cleveland and Pittsburgh division of the Pennsylvania Railroad to succeed S. B. Robertson as general superintendent of the Central system.

George Le Boutillier, formerly superintendent of the Logansport division of the Pittsburgh, Cincinnati, Chicago & St. Louis Railway, succeeds R. K. Rochester as superintendent of the Cleveland and Pittsburgh division of the Pennsylvania Railroad.

Julian C. Field & Company, of Denison, Texas, has been retained to make surveys and report on a proposed toll bridge from Ardmore, Okla., to the Healdton and Fox oil fields. Field work has been started.

J. E. Bebb, office engineer of the

Duluth, South Shore & Atlantic Railway and the Mineral Range Railroad, with office at Duluth, Minn., has resigned effective Jan. 15, to take the position of assistant bridge engineer of the Michigan Central Railroad, with office at Detroit. Mr. Bebb is a graduate of the University of Cincinnati, class of 1905, and was connected with the Michigan Central for a number of years prior to his appointment with the Duluth, South Shore & Atlantic Railway.

R. S. Claar, assistant engineer for the Duluth, South Shore & Atlantic Railway and the Mineral Range Railroad, succeeds J. E. Bebb as office engineer. Mr. Claar was graduated from Armour Institute of Technology in 1912 and soon thereafter went to his present employers. He was also engaged on railroad engineering work before completing his engineering course.

George Mercer, formerly general foreman for the Duluth, South Shore & Atlantic Railway and the Mineral Range Railroad, has been appointed superintendent of bridges and building, with office at Marquette, Mich.

W. Watters Pagon, formerly a member of the firm of J. E. Greiner & Company, consulting engineers, of Baltimore, has opened an office in the Fidelity Building, in that city. Mr. Pagon was graduated from Johns Hopkins University in 1905 and later took a course at Massachusetts Institute of Technology. In 1907, after finishing his studies at Technology, he entered the employ of the Baltimore Bridge Company. Two years later he resigned to become associated with J. E. Greiner. Mr. Pagon is in a position to give special attention to the design, construction and maintenance of all types of movable bridges and to report on conditions and valuation of such structures.

John A. Bensel, formerly state engineer of New York, has been retained by the Board of City Commissioners of Bayonne, N. J., as expert in the proposed development of the South Cove section as a railroad and shipping terminal site.

Earl D. Covell has opened an office in First National Bank Building, Missoula, Mont., for practice in water power, irrigation, water supply and municipal improvement engineering. After graduation from Ohio Northern University in 1906 Mr. Covell was assistant engineer of bridges and buildings of the Cincinnati, Hamilton & Dayton Railway. From 1907 to 1911 he was civil engineer and superintendent of construction for the War Department, in charge of construction of buildings, sewers, water supply, roads and water power at Fort Thomas, Ky., and in Yellowstone Park. From 1911 to 1915 he was engineer for the U. S. Reclamation Service in charge of surveys and construction on the Flathead project and division engineer on Saint Mary's canal. Since 1915 he has been in private practice in charge of construction under contract.

Obituary Notes

Roger Tappan, a civil engineer formerly connected with the Eastern Railroad, of Massachusetts, the construction of the Hoosac Tunnel, railroad surveys in the Adirondacks and in various Western states, died recently at Natick, Mass. He was born at Marshfield, Mass., in 1848, and was a graduate of the Massachusetts Institute of Technology. For many years Mr. Tappan had devoted his time to painting, spending most of his time abroad.

Edward L. Peene, superintendent of the Yonkers, N. Y., water bureau since 1897, died at his residence in that city on Sunday, Dec. 31, 1916. Mr. Peene succumbed to an attack of pneumonia, from which he had been suffering less than a week.

L. L. Williamson, for many years superintendent of the Terre Haute (Ind.) Water Company and later manager of the Helena (Mont.) Water Company, died recently in Terre Haute.

Edward James Jeffery, contractor of Portland, Ore., died in that city recently at the age of 81 years. Mr. Jeffery settled in Portland in 1863, and shortly after that engaged in the contracting business. He constructed tunnels for the Southern Pacific Railroad, a portion of Portland's sewer system, and was one of the builders of the first street railway on Washington Street in Portland.

George F. Richardson, who served as county surveyor of Marin County, California, and city engineer of San Rafael for the past 20 years, died Dec. 20, at the age of 51.

Edward C. Stevens, testing engineer for the R. W. Hunt Company, died Dec. 24 in Trenton, N. J., where he was working in the plant of the John A. Roebling & Sons Company. He had been in the employ of the R. W. Hunt Company about two years. Previous to that he served the Hazard Manufacturing Company and the Safety Insulated Wire Company.

James Skene, contractor, died Dec. 21 at Seneca, S. C., where he was doing work on the line of the Southern Railway. He was born in Aberdeen, Scotland, about 71 years ago. Mr. Skene came to the United States when a young man and spent most of his time in the West, where he was identified with important foundation work.

Civil Service Examinations

United States.—Examinations will be held Feb. 7 for positions with the Interstate Commerce Commission as follows: Civil engineer, salary $720 to $1,680; structural engineer, salary $720 to $1,680; electrical engineer, salary $720 to $1,680; mechanical engineer, salary $720 to $1,680. Form 2039 should be filled in by applicants for any of these positions.

Contractors' Equipment Companies Unite Sales Forces

The Lakewood Engineering Company has just announced that, in addition to its present line of contractors' equipment, it has assumed the sales management of Owens-Wylie concrete chuting systems and of Milwaukee and Wisconsin concrete mixers and street pavers. The new plan contemplates the development of an organization capable of building and marketing a complete line of contractors' equipment, and the volume of business, it is anticipated, will be sufficient to command the services of the best men in the industry.

The personnel of the new organization will be as follows: Charles F. Lang, president, Lakewood Engineering Company; N. F. Teschan, president, Milwaukee Concrete Mixer Company; Roy G. Owens, manager, contractors' equipment department; Lloyd Brown, manager car department; W. A. Meddick, assistant manager, car department; H. Walter Sykes, manager, electrical industrial equipment; W. G. Grail, manager, clamshell bucket department; V. Truelson, chief engineer, Milwaukee plant; James Lockhart, chief engineer, car department, Cleveland; Thomas D. Maley, chief engineer, contractors' equipment, Cleveland; Henry T. Pleines, general superintendent, Cleveland.

The slogan of the new organization will be "Link up with Lakewood."

New Reinforcing Plate Adds to Strength of Building

The Berger Manufacturing Company, Canton, Ohio, has brought out a new ribbed reinforcing plate named Ribplex. The design is a network of strands forming meshes between V-shaped stiffening or supporting ribs. These ribs have an inverted arch-shaped formation at their base, from which the turned-on-edge mesh strands start.

This combination is said to increase the strength greatly and make the plate more rigid. Ribplex is a combined centering and reinforcement, especially used for reinforcing floors, roofs, side walls, partitions, stucco construction, suspended ceilings, and practically all kinds of construction where concrete or plaster is used. The small meshes formed between the ribs prevent the soft concrete from running through, and make a good bond with the concrete so that it is possible to develop the full tensile value of the metal.

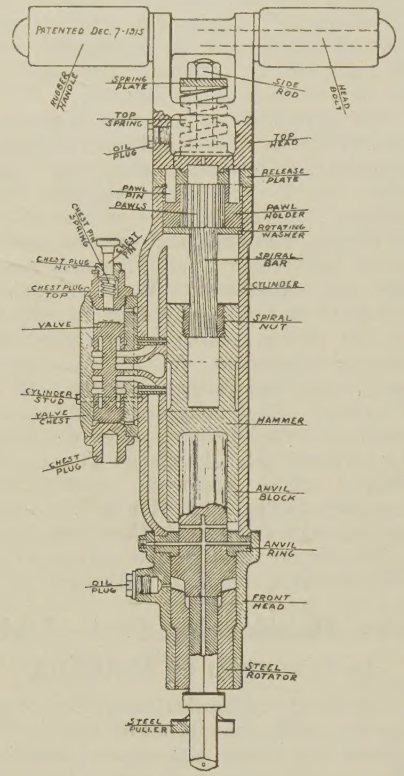
Truck to Mark Western Roads

A Federal motor truck has been specially equipped by the California State Automobile Association for marking and scouting roads in the coast states. On the running boards by the driver's seat are two large tanks holding more than 40 gal. One is for gasoline, the other for water. A third tank is extended from the frame on the left side of the truck to carry 5 gal. of oil.

With this equipment the truck will be able to travel from 400 to 600 miles without adding fuel or water.

New Self-Rotating Hammer Drill Automatically Cleans Hole

The Wood Drill Works, of Paterson, N. J., have just placed on the market a self-rotating hammer drill that automatically cleans the hole. If by chance the air going through the steel is not enough to clean the hole, by pressing down the button at the top of the chest the full pressure of air is directed to the drill point, cleaning the hole of all cuttings at once. By releasing the button, the drill starts automatically.



DRILL AUTOMATICALLY CLEANS HOLE

One of the advantages claimed for this drill is the absence of piston breakage; another is that no collars are required on the steels, thereby eliminating a great deal of the blacksmith trouble. The hollow piston always strikes squarely on the anvil block. It is necessary only to cut the steel squarely, temper it, and push it up against the anvil block of the drill. The cylinder and chest is made of vanadium-tungsten iron. It is self-oiling, and has soft-rubber grips on the handle, which reduce the vibration on the operation.

Wants Information on Pumps, Engines and Generators

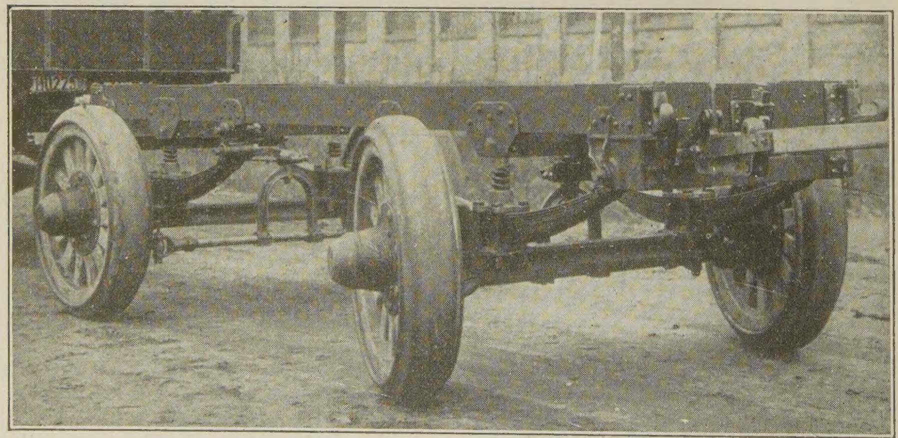
Complete information on combined gasoline engines and pumps and combined gasoline engines and electric generators is wanted by H. Erickson, captain, Quartermaster Corps, U. S. A., Fort Sam Houston, Tex.

Heavy-Duty Trailers Have Special Hitch

In a new series of four-wheel, heavy-duty trailers being put on the market the special feature is the hitch-bar attachment. This bar fastens over a ball to be attached to the rear end of the truck in a self-locking manner, forming a universal joint which provides a safe and flexible connection with the truck. The hitch bar is carefully machined, and fits over the locking end of the drawbar. This enables the driver to lay the connecting bar upon the drawbar, back up the truck, and effect an automatic hitch without any assistance. There are no lock pins, chains, or other fastening devices.

By means of a hinged yoke, the drawbar oscillates over the tie-rod yoke forming a universal joint, making the steering mechanism entirely independent of the frame. It is claimed that the shock of the load while traveling is not communicated to the steering arms of the wheels, which would cause a sidewise friction of the tires on the roads. In other words, the arrangement permits the wheels to remain parallel to the line of traction without wabbling or side motion.

The trailers are made in five sizes, 1½, 2½, 5 and 7-ton and 4-yd. gravel capacities. Six auxiliary heavy steering hooks are fastened to the corners and to each drawbar to form additional points for hitching the connecting bar when in tight places. These trailers are made by the Warner Manufacturing Company of Beloit, Wis.



STEERING ARMS OF WHEELS ARE INDEPENDENT OF LOAD SHOCK

Business Notes

Troy Wagon Works Company of Troy, Ohio, has appointed the Lone Star Motor Company of El Paso, Tex., as representative for Troy trailers. The territory includes El Paso and all of New Mexico south of Albuquerque.

Warren Webster & Company of Camden, N. J., have disposed of the business of the air-conditioning department. Since Jan. 1 the Webster air-conditioning apparatus has been manufactured and exploited by the Braemer Air Conditioning Corporation, Lafayette Building, Philadelphia.

Link Belt Company has blown in the fifth furnace at the Belmont plant, Indianapolis. This adds materially to the company's capacity for producing malleable Link-Belt. Extensive building operations at the Belmont works have been completed and the manufacturing activities reorganized to keep pace with increasing business.

Hydrometric Company of Los Angeles, Cal., has recently been incorporated, and opened offices in the Central Building. The firm will handle a general line of hydraulic and meteorological instruments.

Pulsometer Steam Pump Company has authorized the Mays & Talley Company to open a new branch in the Penobscot Building, Detroit, for the distribution of Pulsomoter pumps.

Trade Publications

The following companies have recently issued trade literature:

David Lupton's Sons Company, Philadelphia. Catalog 9, 8½ x 11 in.; 98 pages; illustrated. Contains detailed information concerning problems in daylight ventilation, treating especially foundries, forge shops, glass furnaces, power houses, machine shops, textile mills, office buildings and hospitals. Various types of steel sash and roof construction are well illustrated. Pond truss is illustrated and details given. Steel partitions and doors are included, also rolled steel skylights and sheet metal fireproof windows, in addition to much useful data for designers.

Link-Belt Company, Chicago. Booklet 286, 6 x 9 in.; illustrated. Treats of Link-Belt silent chain and Link-Belt casing.

Dayton-Dick Company, Quincy, Ill. Bulletin 19, 7½ x 10 in.; illustrated. Dayton pumping outfits for contractors, sump and bilge pumping and irrigation.

Alexander Milburn Company, Baltimore. Catalog 5, 7¾ x 10⅝; 32 pages; illustrated. Oxyacetylene welding and cutting apparatus.

Stegeman Motor Car Company, Milwaukee. Catalog 221 describes six-cylinder worm-drive, 1½ to 5-ton trucks, with a page on horse versus truck costs.

Pelton Water Wheel Company, San Francisco. Bulletin 9, describing and illustrating the Pelton-Doble centrifugal pump.